Water management in Ontario

Ontario
Water Resources
Commission

District
Engineers
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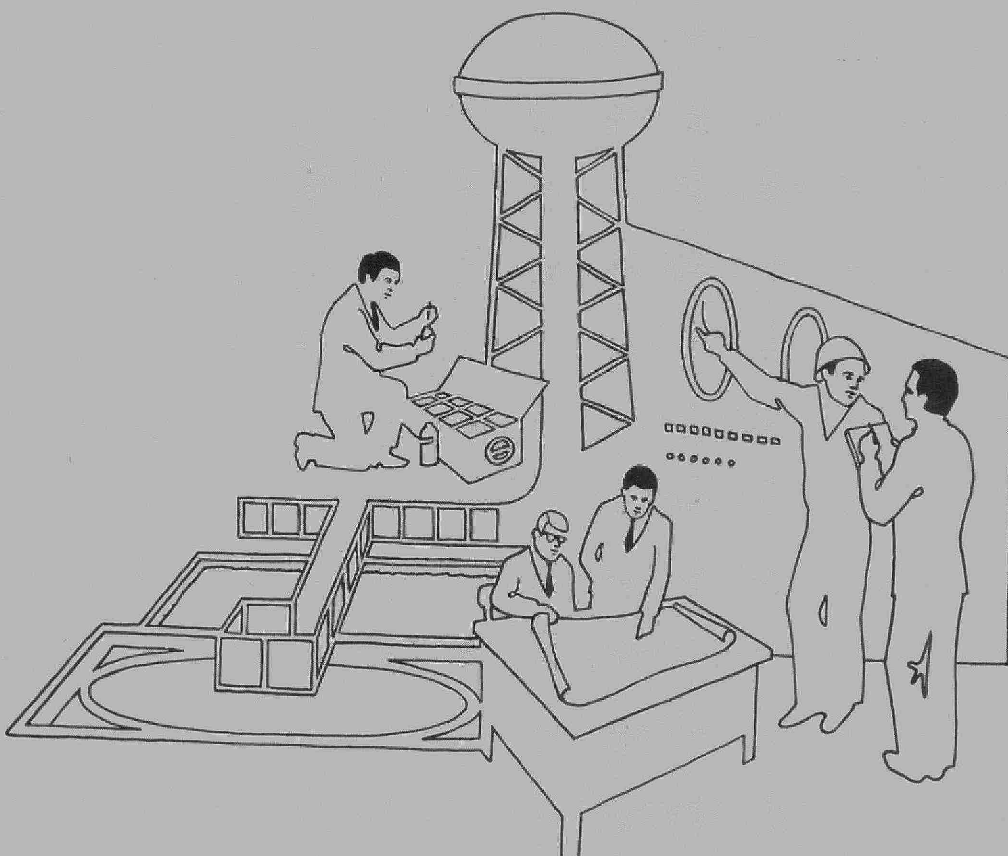
Water Pollution Survey



WATER POLLUTION SURVEY

of the

TOWN OF WHITBY

1971

THE

ONTARIO WATER RESOURCES

COMMISSION

REPORT ON A

WATER POLLUTION SURVEY

OF THE

TOWN OF WHITBY

DIVISION OF SANITARY ENGINEERING

DISTRICT ENGINEERS BRANCH

MARCH 1971

TOWN OF WHITBY

WATER POLLUTION SURVEY REPORT

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TOWN OF WHITBY

WATER POLLUTION SURVEY REPORT

INTRODUCTION:

During the weeks starting November 16, 1970 and November 23, 1970, a water pollution survey was made by Commission staff in the Town of Whitby.

This type of survey is intended to locate sources of contamination which may adversely affect the quality of the ground water or surface water. Corrective measures are recommended to the responsible persons when unsatisfactory conditions are discovered.

Samples were collected from the various watercourses and outfalls throughout the town. The samples collected were submitted to the OWRC Laboratory in Toronto for chemical analyses and bacteriological examination. The significance of the various tests used to assess the water quality has been explained in the appendix I.

Interviews were conducted with various officials of the Town of Whitby and the Oshawa-Ontario County Health Unit. Their co-operation was most appreciated.

TOWN OF WHITBY:

The Town of Whitby is located 28 miles east of the City of Toronto, on the northshore of Lake Ontario. The municipal boundaries enclose an area of 56.6 square miles. The present

population of Whitby is nearly 24,000. There is approximately 5.5 miles of frontage on Lake Ontario (excluding Whitby Harbour) and the northern most limit of the town, is situated 12 miles from Lake Ontario.

Most of the development in the Town of Whitby is confined to the southern area of the town. A large residential development is located at Brooklin in the northern section of the town. The remainder of the town has some small pockets of residential development such as Ashburn, Macedonian Village and Myrtle but otherwise most of the area is used for farming.

The type of water and sewage services available varies throughout the town. In the southern portion where most development has occurred, both municipal water and sewerage services are available. In the remainder of the town, there are no municipal sanitary sewer services provided and with the exception of the Brooklin area, the individual property owners must rely on individual water supplies. In order to obtain a reliable water supply, several co-operatives have been formed and have built their own communal water supply systems.

SURFACE WATERS:

Drainage from the Town of Whitby flows either directly or indirectly into Lake Ontario. A list of the watercourses in Whitby would include Lynde Creek, Pringle Creek, Corbett Creek and Oshawa Creek.

The most extensive drainage system in the town is the Lynde Creek system. It is estimated that the total drainage area of Lynde Creek is almost 47 square miles which includes parts of the Townships of Reach and Pickering as well as the Town of Whitby. Lynde Creek drains all of the north end of the town with the exception of a small area along the east side of the town, which drains to Oshawa Creek. In the southern area of the town, Lynde Creek flows through the western edge of the developed area.

Pringle Creek originates in the 4th concession of the town. The drainage basin of Pringle Creek is quite narrow and is estimated to contain an area of 11 square miles. Pringle Creek flows through the eastern side of the southern section of the town.

Corbett Creek originates in the 2nd concession of the town. Its drainage area is approximately 5 square miles and includes part of the City of Oshawa as well as the Town of Whitby.

Oshawa Creek drains a small area of the Town of Whitby along the eastern boundary of the town, north of Highway #7. This watercourse was not included in the field investigation because of the sparse development. A water pollution survey of the City of Oshawa was released by the Commission early in 1971, and includes information on the quality and sources of pollution on the southern section of the Oshawa Creek.

WATER SUPPLY:

There are two municipal water systems in the Town of Whitby and several small co-operatives. One of the municipal water distribution systems is located in the southern area of the town and the other is located at Brooklin. The 'co-operative' water works are located in the area adjacent to the City of Oshawa.

The municipal water distribution system in the southern area of the town obtains its water supply from Lake Ontario. The Brooklin water system and co-operative water systems obtain their water supply from ground water sources.

The Lake Ontario supply serves primarily the urbanized section of the municipality i.e. the original townsite. At the present time there are approximately 4300 services on this supply. The water treatment plant is located on Lake Ontario east of Whitby Harbour. The treatment provided includes, flocculation, sedimentation, filtration, chlorination and fluoridation. Chlorine dioxide treatment is provided for taste and odour control. The present rated capacity of the plant is 2.456 mgd, but it is possible that the present capacity can be upgraded without a large expansion programme because of the present type of filter media being used. An engineering study of the existing facilities will be required to determine whether this is feasible.

Complaints of tastes and odours in the treated water have been received on several occasions during the past few years, but the

treatment at the water works has always been generally satisfactory.

A typical sample of treated water would show the following chemical characteristics:

Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab	Fluoride as F	Apparent Colour Units	Turbidity Units
136	97	0.07	30	8.1	0.8	<5	2

The raw water intake conduit extends approximately 2500 feet into the lake. There is approximately 28 feet of water above the intake. The raw water at the intake (at its present location), is occasionally affected by Pringle Creek. During the past few years phenolic type wastes have been responsible for taste and odour problems at the water works. The apparent source of these wastes has been Pringle Creek. On various occasions 'slugs' of phenolic type wastes have been received at the sewage treatment plant. Some reduction is provided at the sewage treatment plant, but a considerable amount of the phenols remain in the effluent which is discharged to Pringle Creek and thus affects the raw water quality at the water treatment plant intake when certain wind conditions prevail.

The raw water bacterial sampling programme at the water works indicates that the raw water quality generally meets the desirable criteria range for the type of treatment provided (i.e. <100 coliforms bacteria per 100 ml).

The Brooklin water works obtains its water supply from ground water sources. There are two drilled wells but only one well is being used at the present time to supply water to 420 services. The capacity of this water works has been rated at 0.216 mgd

and the water works has been able to meet the present consumer demands. Chlorination and filtration equipment provides treatment to control staining and sediment formation problems due to the high concentration of iron in the raw water. The concentration of iron in the raw water has averaged 0.68 ppm during the past three years. A typical sample of treated water collected at the pumphouse would indicate the following concentrations:

Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab
259	228	0.09	7	7.6

Our records indicate that the bacterial quality of the raw water has always been excellent.

There are three co-operative water supply systems known to Commission staff in the Town of Whitby. The water quality of these supplies has been generally satisfactory and no treatment is being provided.

The remainder of the residents of the town obtain a water supply on an individual basis. The majority utilize ground water as the source of their water supply.

WASTE DISPOSAL FACILITIES:

SANITARY WASTES:

The disposal of sanitary wastes in the Town of Whitby is provided by private individual sub-surface disposal facilities or by the municipal sewage treatment plant facilities.

The municipal sewage treatment plant serves the densely developed area in the southern section of the town. All development in the remainder of the town utilizes septic tank or pit privies which must meet the standards set by the local Medical Officer of Health.

The Whitby Municipal Sewage Treatment Plant is located south of Highway #401 on the west side of Pringle Creek. It is an activated sludge type sewage treatment plant and provides secondary treatment. During 1970 work was completed on an expansion of the sewage treatment facilities at this plant. The present design capacity is 3.25 mgd. Past operating problems due to overloading of the sewage treatment facilities during the canning season caused serious deterioration in the downstream water quality of Pringle Creek. The increase in treatment capacity at the sewage works should provide protection to the water quality of the creek.

At the present time there are eight sewage pumping stations in the sewage collection system. Inspections were made at each pumping station having overflow facilities during the field investigations in November 1970. There was no evidence of any overflows at this time. It is reported that all sewage pumping stations are connected by an alarm system so that repairs can be made as soon as possible should any problems develop. Although there was no evidence of overflows at pumping stations during the survey, it was subsequently learned that in the spring of 1971 run-off resulted in overflows at a number of locations in the system. This would indicate that storm and/or groundwater was gaining access to the sanitary collector sewers. This problem should be investigated and corrected.

Due to the limited assimilative capacity of Pringle Creek, the present sewage treatment plant will not be further expanded to

meet the long term needs of Whitby. There are plans for a second sewage treatment plant to be located at the mouth of Corbett Creek. This plant will service the eastern side of the Town of Whitby and part of the City of Oshawa. This will reduce the loading on the present sewage facilities and provide capacity for future growth.

INDUSTRIAL WASTES:

There are 34 manufacturing plants in the Town of Whitby. Most of those plants in the sewered area of the town direct their wastes to the municipal sewage treatment plant. Some industries such as Stokely Van Camp of Canada Ltd. and Nutria Products Ltd. provide primary treatment of their wastes before being discharged to the sanitary sewer system.

Our Division of Industrial Wastes keeps a regular check on those industries which discharge waste water to any watercourse. Industries such as Dupont of Canada Ltd. and Dunlop of Canada Ltd. discharge waste cooling water to drainage ditches, but the water quality of these effluents has been satisfactory. The Lake Ontario Steel Company Ltd. directs bleed-off water and scrubbing water to two large settling ponds. Alum treatment and oil skimming are provided prior to the discharge of the waste water to the settling ponds. The effluent from the settling ponds is directed to a drainage ditch which flows into Lake Ontario. The high concentrations of iron and suspended solids in the waste water are our main concern. The present facilities are however providing adequate treatment.

The Lofthouse Brass Manufacturing Co. has a small volume of spent acid, lime and acidified water (100 gals. per day) which it directs to a seepage pit. This appears to be satisfactory.

SOLID WASTE:

The Town of Whitby opened a new sanitary landfill site in the 5th concession on lots 29 and 30 in 1970. This replaces the previous site which was located east of Highway #12 and south of Brooklin. The abandonment of the old site became necessary because of the potential pollution due to a high water table. A sample of runoff water from this area shows high concentration of chloride and sodium. An unprotected stock pile of road salt was probably responsible for the high concentrations of chloride and sodium. The road salt storage pile should be relocated to a more suitable area and/or measures taken to control seepage. Preventive measures should be taken to protect the gound and surface water quality from such chemicals.

The new sanitary landfill site will occupy a disposal area of approximately 25 acres. It is expected that this site will serve the needs of the town for the next 5 years. A ground and surface water quality monitoring programme is being carried out by municipal employees to assess the effect of the sanitary landfill operation.

POLLUTION SURVEY:

During the weeks starting November 16, 1970 and November 23, 1970, field investigations were carried out in the Town of

Whitby to locate any source of contamination which might adversely affect the ground or surface water quality. While the field work was in progress there were brief periods of rain and snow, but the conditions were not greatly affected by the precipitation.

One set of samples was collected throughout the municipality from drainage courses and outfalls. A second set of samples was collected from the built-up areas of the town.

PRINGLE CREEK:

Samples were collected at 22 locations throughout the Pringle Creek watershed. Ten of the samples collected were from outfalls or small tributary drainage courses.

The water quality of Pringle Creek north of Rossland Road in general was satisfactory. One exception was a small watercourse next to Wilson's Abattoir. The sample results here show evidence of contamination.

Below Highway #2 the influences of an urban area can be seen. Grocery shopping carts, pieces of metal, dressed lumber and garbage can be seen in the creek bed. It is in this area that the Laboratory results show evidence of sanitary wastes.

South of Highway #401 no evidence of sanitary wastes being discharged was found. The most noticeable water quality change in this area of Pringle Creek is the large increase in nitrogen and phosphorus concentrations. The effluent from the municipal sewage treatment plant is the chief source of these nutrients.

The following list of outfalls and drainage ditches had unsatisfactory effluents:

PR - 4.8D

This drainage ditch is a tributary to Pringle Creek north of Rossland Road. The ditch drains the area of Wilson's Abattoir. The sample results show an excessive number of coliform bacteria and a high concentration of organic nitrogen.

PR - 2.90W

This storm sewer outfall is located on the east side of Pringle Creek at the west end of Dunlop Street East. The sample results indicate the presence of sanitary wastes. There are excessive numbers of coliform bacteria present and there is a high concentration of organic nitrogen at various stages of decomposition.

PRT - 1.98W (S)

This storm sewer outfall is located at the east end of Ontario Street East. The sample results show excessive numbers of coliform bacteria.

A summary of the laboratory results of the samples collected from Pringle Creek has been included in the appendices in Table I.

LYNDE CREEK:

The Lynde Creek drainage system consists of three major branches. In this report they have been designated as Lynde Creek (Main Branch), Lynde Creek (East Branch) and Lynde Creek (West Branch). A summary of the laboratory results pertaining to the samples

collected from the various branches of Lynde Creek have been included in the appendices in Tables II (A), II (B), and II (C).

During the field investigations in November, samples were collected at 45 locations in the Lynde Creek watershed.

LYNDE CREEK (MAIN BRANCH):

The main branch of Lynde Creek flows through an area of scattered development. There were 16 sampling locations along the main branch of Lynde Creek. The sample results indicate that the water quality of this branch was very good. The results show moderate amounts of nitrate nitrogen in the creek but this is not unusual when you consider the type of areas the creek flows through. The storm sewer outfall at sampling point number LY-3.4W had an effluent with a moderate number of coliform bacteria present but the other test results are generally satisfactory and so it would appear that the bacterial results are due to street run-off.

LYNDE CREEK (EAST BRANCH):

The east branch of Lynde Creek originates as an overflow from Chalk Lake in the Township of Reach. This branch of the creek drains the most developed areas of the Lynde Creek watershed. Drainage from Ashburn and Brooklin flow into this branch of Lynde Creek. The laboratory results indicate that there are several problems in the Brooklin area.

The following list of outfalls had unsatisfactory effluents.

LYE 10.5W (W)

This storm sewer outfall is located on the west side of Lynde Creek (East Branch) on the south side of the Winchester Road Bridge. The laboratory results indicate the presence of excessive numbers of coliform bacteria and a high concentration of organic material in the effluent from this storm sewer.

LYE - 10.5W (E)

This storm sewer outfall is located on the east side of Lynde Creek (East Branch) south of the Winchester Road Bridge. The laboratory results indicate that the effluent contained an excessive number of coliform bacteria, an excessive Biochemical Oxygen Demand plus a very high concentration of organic material.

LYE 10.7 W

This storm sewer outfall is located on the east side of Lynde Creek (East Branch) on the south side of Cassels Road East. The laboratory results indicate that the effluent was carrying sanitary wastes. The bacterial samples collected showed the presence of excessive numbers of coliform bacteria. The Biochemical Oxygen Demand of the effluent was high and the concentrations of nitrogen and phosphorus in the effluent indicates the presence of fresh organic materials.

LYE - 10.9 W

This storm sewer outfall is located on the south side of Lynde Creek (East Branch) west of Highway #12. There was a substantial amount of foam around the mouth of the outfall at the time the samples were collected. The laboratory results indicate the

presence of sanitary wastes. The Biochemical Oxygen Demand of the effluent was very high and coliform bacteria were present in very large numbers. The effluent had a significant concentration of organic material present.

LYE - 11.2 W

This storm sewer outfall is located on the south side of Lynde Creek just west of the water works. The sample results indicate the presence of excessive numbers of coliform bacteria in the effluent. The results of the nitrogen tests indicate that the contamination may be due to seepage into the storm sewer rather than a direct connection.

LYNDE CREEK (WEST BRANCH):

This branch of Lynde Creek is the smallest of the three branches. It originates in the vicinity of Highway #7 near the municipal boundary between the Town of Whitby and the Township of Pickering. This branch drains an area which has relatively little development and the sample results reflect this feature. During the field investigations in November 1970, there were no apparent problems. In the lower section of this branch of Lynde Creek the flow is relatively slow and there is a considerable amount of aquatic vegetation. The nitrogen and phosphorus test results indicate that the water is moderately rich in organic material. The farms along the creek and the decomposing vegetative matter are undoubtely responsible for the high concentration of nitrogen and phosphorus present.

CORBETT CREEK:

Corbett Creek drains a relatively small area. It originates north of Highway #2 in a residential area and flows south through a mixed commercial-industrial area to Lake Ontario. Samples were collected at five locations along the creek. The laboratory results are summarized in Table III in the appendices at the back of the report.

The sample results were generally satisfactory. There were no apparent problems at the time the samples were collected.

LAKE ONTARIO:

The laboratory results of 9 samples collected along Lake Ontario and Whitby Harbour during November 1970 are summarized in Table IV. The sample results were generally within the expected ranges. No outstanding sources of pollution were evident at the time of sampling.

The sample results show that Whitby Harbour is rich in nutrients. The major source of nutrient material comes from the Municipal Sewage Treatment Plant by way of Pringle Creek.

On August 6, 1970, the Oshawa-Ontario County Health Unit advised the municipal officials of the Town of Whitby that they would be posting the Whitby Hospital Beach as being unsafe for swimming due to excessive bacteriological pollution. An investigation was made of the likely sources of contamination in the immediate area. There are no known sources of raw sewage discharges in this area. The sewage treatment plant at the Ontario Hospital Complex chlorinates the treated effluent before being discharged to Lake

Ontario. The operator at the sewage plant has always been conscientious in regard to the treatment of the sewage. Sample results from this plant have been generally satisfactory.

During the past summer the Whitby sewage Treatment Plant was experiencing disinfection problems. High bacterial counts were recorded in Pringle Creek at the harbour. It is our understanding that the lake currents in this area flow toward the Town of Ajax most of the time. Any wastes directed to Pringle Creek would eventually pass through the harbour area and probably effect the shoreline west of the harbour.

It appears that the effluent from the Whitby Municipal Sewage Treatment Plant was responsible for the high numbers of coliform bacteria detected at the Whitby Hospital Beach. A study is being made by our Division of Research to help solve the disinfection problem which has occurred previously during the summer season. With the expansion of the plant in late 1970, better treatment and disinfection should be possible during the forthcoming recreational seasons.

SUMMARY:

A water pollution survey was made of the Town of Whitby during the month of November. Samples were collected from the major watercourses in the town.

There are several pollution problems in the Town of Whitby. These are mainly in the developed areas of the town. In the Brooklin area there are five storm sewer outfalls along Lynde Creek which showed evidence of sanitary wastes. In the southern section of the town the sample results from two storm sewer outfalls to Pringle Creek showed evidence of sanitary wastes.

These storm sewers should be inspected by the concerned authorities to determine the sources of the contamination and corrective measures should be taken to prevent any sanitary wastes gaining access to the storm sewers. There is also a problem of overflows from the sanitary sewer system caused by the access of storm and/or groundwater into the sanitary sewers.

There were some unsatisfactory results obtained in the samples collected near Wilson's Abattoir. Commission staff will be investigating the area around Wilson's Abattoir to determine whether any pollution control measures are required.

RECOMMENDATIONS:

1. The Town of Whitby should initiate a programme to investigate its storm sewer system to locate all sources of untreated and/or inadquately treated wastes gaining access to its storm sewer system and thence to drainage courses.

2. The sources of untreated and/or inadquately treated wastes gaining access to the storm sewers should be eliminated.

3. The problem of overflows from the sanitary sewerage system caused by storm and/or groundwater gaining access to the sewers should be investigated and corrected.

Prepared by: J. A. Clarke

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Technologist,
Division of Sanitary Engineering

JAC:bm

APPENDIX I

TOWN OF WHITBY

WATER POLLUTION SURVEY

-1970-

WATER QUALITY AND EFFLUENT OBJECTIVES

N.B. A pamphlet entitled

"Guidelines and Criteria

for

Water Quality Management

in

Ontario" has been enclosed

in the map pocket at the back of the report.

APPENDIX I

WATER QUALITY AND EFFLUENT OBJECTIVES

The OWRC objectives for surface waters is described in a booklet entitled "Guidelines and Criteria for Water Quality Management in Ontario". A copy of the booklet is enclosed in the pocket on the back cover of this report. This publication contains the guidelines and introduces water quality criteria for various uses including public, agricultural and industrial water supply, recreation, aesthetic enjoyment and the propagation of fish and wildlife. The guidelines should be followed to determine the acceptability of a watercourse for various uses.

A few pertinent maximum limits of contaminants in sewage treatment plant and industrial effluents are listed below. Adequate protection for surface waters except in certain specific instances influenced by local conditions, should be provided if the following concentrations and pH range are not exceeded.

5-Day BOD - not greater than 15 ppm
Suspended Solids - not greater than 15 ppm
Phenols - not greater than 20 ppb
pH - 5.5 to 10.6
Iron - not greater than 17 ppm
Ether solubles (Oil) - not greater than 15 ppm

GLOSSARY OF TERMS

Bacteriological Examinations - The Membrane Filter Technique is used to obtain a direct count of coliform organisms. These or-

ganisms are the normal inhabitants of the intestines of man and other warm-blooded animals and soils. They are always present in large numbers in untreated sewage and are, in general, relatively few in number in other stream pollutants. The fecal portion of the total coliforms originate only in the intestines of man and warm blooded animals and indicate recent pollution.

Sanitary Chemical Analyses

Biochemical Oxygen Demand (BOD)

Biochemical Oxygen Demand is reported in parts per million (ppm) and is an indication of the amount of oxygen required for the stabilization of the decomposable organic or chemical matter in the water. The completion of the laboratory test requires five days, under the controlled incubation temperature of 20^{o} Centigrade.

Solids

The value for solids, expressed in parts per million (ppm) is the sum of the values for the suspended and the dissolved matter in the water. The concentration of suspended solids is generally the most significant of the solids analyses with regard to surface water quality.

The effects of suspended solids in water are reflected in difficulties associated with water purification, depositions in streams and injury to the habitat of fish.

Nitrogen

Ammonia Nitrogen (Free Ammonia) is the soluble product in the decomposition of nitrogenous organic matter, it is also formed when nitrates and nitrites are reduced to ammonia either biologically or chemically. Some small amount of ammonia, too, may be swept out of the atmosphere by rain water.

The following values may be of general significance in appriasing free ammonia content: Low 0.015 to 0.03; Moderate 0.03 to 0.10 ppm; High 0.10 or greater.

Total Kjeldahl is a measure of the total nitrogenous matter present except that measured as nitrite and nitrate nitrogens. The Total Kjeldahl less the Ammonia gives a measure of the organic nitrogen present. Ammonia and organic nitrogen determinations are important in determining the availability of nitrogen for biological utilization. The normal range for Total Kjeldahl would be 0.1 to 0.5 ppm.

Nitrite Nitrogen

Nitrite is usually an intermediate oxidation product of ammonia. The significance of nitrites, therefore, varies with their amount, source and relation to other consitituents of the sample, notably the relative magnitude of ammonia and nitrate present. Since nitrite is rapidly and easily converted to nitrate, its presence in concentrations greater than a few thousandths of a part per million is generally indicative of active biological processes in water.

Nitrate Nitrogen

Nitrate is the end product of aerobic decomposition of nitrogenous matter, and its presence carries this significance. Nitrate concentration is of particular interest in relation to the other forms of nitrogen that may be present in the sample. Nitrates occur in the crust of the earth in many places and are a source of its fertility.

The following ranges in concentration may be used as a guide. Low, has less than 0.1 ppm; Moderate, 0.1 to 1.0 ppm; High, greater than 1.0 ppm.

Phosphorus

Total Phosphorus

Total Phosphorus is a measure of both the organic and inorganic forms of phosphorus present.

Soluble Phosphorus

Soluble Phosphorus is a measure of the orthophosphate only and when subtracted from the total phosphorus gives an indication of the concentration of organic phosphorus present. That is, the soluble phosphorus is a measure of the inorganic phosphorus present except the phosphorus in the form of polyphosphate, which however, in surface waters is usually insignificant. Inorganic phosphorus in concentration in excess of 0.1 ppm may cause nuisance conditions.

APPENDIX II

TOWN OF WHITBY

WATER POLLUTION SURVEY

1970

SAMPLE RESULTS

TABLES I - IV

All analyses in ppm except where indicated

Town of Whitby

Water Pollution Survey

Table I

Pringle Creek
Samples Collected by:
D. Cameron
J. Clarke

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N TOTAL KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
PR-0.8	PRINGLE CREEK AT BROCK	19/11/70	2.0	400	10	390	80	1,100	0.30	1.0	0.138	4.0	—	1.4
	STREET SOUTH	23/11/70	1.2	610	<15	—	4	16	0.27	1.0	0.021	6.5	1.8	1.8
PR-1.021D	DRAINAGE DITCH FROM	19/11/70	5.5	240	15	225	20	1,500	0.04	0.60	0.010	0.02	0.24	0.13
	DUNLOP OF CANDA LTD	23/11/70	2.5	230	<15	—	40	600	0.02	0.39	0.018	0.55	0.21	0.15
PR-1.14	PRINGLE CREEK AT WATSON	19/11/70	2.0	520	10	510	<4	<4	0.17	0.82	0.018	9.0	2.8	2.0
	STREET EAST	23/11/70	1.8	630	<15	—	<4	600	0.13	0.91	0.014	8.5	2.5	2.3
PR-1.41	PRINGLE CREEK AT GRAND	19/11/70	3.0	560	10	550	<4	<4	0.10	0.93	0.030	9.8	2.9	2.4
	TRUNK STREET	23/11/70	1.8	650	<15	—	<4	12	0.05	1.0	0.004	10.0	3.5	2.8
PR-1.44T	SOUTH OUTFALL FROM	19/11/70	1.0	530	5	525	<4	<4	0.03	0.51	0.005	15.0	0.18	0.13
	MUNICIPAL STP	23/11/70	0.8	720	<15	—	<4	<10	0.02	0.95	0.002	14.0	4.4	3.9
PR-1.46T	NORTH OUTFALL FROM	19/11/70	5.5	660	15	645	48	6600	0.24	1.5	0.144	22.0	7.6	6.7
	MUNICIPAL STP	23/11/70	6.0	800	<15	—	48	68	0.03	1.8	0.003	21.0	5.0	4.0
PR-1.75W	STORM DRAIN JUST BELOW	19/11/70					124	7,300						
	HIGHWAY 401	23/11/70					500	3,900						
PR-1.751D	DRAINAGE DITCH FROM	19/11/70	1.6	260	10	250	12	40	0.04	0.39	0.005	<.01	0.073	0.032
	SKLAR FURNITURE COMPANY	23/11/70	3.0	400	<15	—	40	50	0.03	0.68	0.010	0.31	0.080	0.022
	LIMITED													
PRT-1.98	TRIBUTARY OF PRINGLE	19/11/70	1.8	550	5	545	300	1,500	0.10	0.77	0.018	1.2	0.15	0.093
	CREEK AT END OF ONTARIO	23/11/70	1.2	610	<15	—	7,300	11,500	0.04	0.64	0.010	0.47	0.28	0.14
	STREET EAST													

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N TOTAL KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
PRT-1.98W(S)	STORM SEWER OUTFALL AT END OF ONTARIO STREET EAST	19/11/70	1.2	570	5	565	400	2,200	0.17	0.39	0.026	1.6	0.11	0.078
		23/11/70					28,000	59,000						
PRT-1.98W(N)	STORM DRAIN AT END OF ONTARIO STREET EAST	19/11/70					<4	44						
		23/11/70					40	200						
PRT-3.10	TRIBUTARY OF PRINGLE CREEK AT HIGHWAY 2	19/11/70	15.0	530	15	515	4	900	0.02	0.56	0.003	<.01	0.18	0.054
PRT-3.88	TRIBUTARY OF PRINGLE CREEK AT HIGHWAY 12	19/11/70	2.5	565	5	560	50	2,700	0.03	0.56	0.003	<.01	0.10	0.082
		23/11/70	0.4	560	<15	—	56	408	0.01	0.71	0.004	0.01	0.015	0.008
PR-2.43W	STORM SEWER OUTFALL AT END OF CONSUMER'S DRIVE	19/11/70	1.0	350	5	345	<4	<4	0.09	0.29	0.29	2.8	0.003	0.002
PR-2.44	PRINGLE CREEK ABOVE JUNCTION WITH TRIBUTARY	19/11/70	1.4	410	10	400	340	3,800	0.02	0.47	0.009	0.11	0.042	0.004
PR-2.90W	STORM SEWER OUTFALL AT DUNLOP STREET	19/11/70	8.0	670	10	660	97,000	340,000	3.2	4.0	0.46	1.6	0.50	0.39
		23/11/70	3.0	670	<15	—	3,500,000	11,000,000	0.17	0.80	0.058	2.0	1.1	0.20
PR-3.10	PRINGLE CREEK AT HIGHWAY 2	19/11/70	2.5	460	5	455	81	200	0.03	0.38	0.005	0.06	0.020	0.007
		23/11/70	1.0	510	<15	—	408	2,300	0.06	0.94	0.008	0.27	0.13	0.011
PR-3.35	PRINGLE CREEK AT CPR BRIDGE	19/11/70	1.4	410	5	405	208	1,100	0.03	0.37	0.005	0.06	0.024	0.007
		23/11/70	0.4	500	<15	—	380	900	0.06	0.50	0.005	0.18	0.018	0.008
PR-4.7	PRINGLE CREEK AT ROSSLAND ROAD	19/11/70	2.5	440	15	425	900	1,600	0.06	0.56	0.028	0.20	0.084	0.014
PR-4.8D	TRIBUTARY TO PRINGLE CREEK ADJACENT TO WILSON'S ABATTOIR	19/11/70	6.0	820	340	480	13,000	16,000	0.05	2.6	0.063	0.45	0.65	0.056

Table I Cont'd

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N TOTAL KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
PR-6.2	PRINGLE CREEK AT COUNTY ROAD NO 4	19/11/70	1.0	350	5	345	4	32	0.01	0.29	0.002	0.30	0.79	0.003
PR-6.8	PRINGLE CREEK AT THICKSON ROAD	19/11/70	1.6	370	5	365	4	24	0.06	0.36	0.010	0.37	0.025	0.008

All analyses in ppm except where indicated

Town of Whitby

Water Pollution Survey

Table II(a)

Lynde Creek (Main Branch)
Samples Collected by:
D. Cameron
J. Clarke

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N TOTAL KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
LY-0.1	LYNDE CREEK (MAIN BRANCH) NEAR LAKE ONTARIO	17/11/70	2.0	320	5	325	48	124	0.07	0.54	0.015	0.36	0.048	0.020
LY-1.2	LYNDE CREEK (MAIN BRANCH) AT VICTORIA STREET WEST	17/11/70	1.4	330	5	325	40	64	0.02	0.40	0.014	0.51	0.040	0.026
LYP-2.8	TRIBUTARY OF LYNDE CREEK (MAIN BRANCH) AT VICTORIA STREET WEST	17/11/70			N O	F L O W								
LY-3.4W	STORM SEWER OUTFALL ON NORTH SIDE OF HWY 2, EAST OF LYNDE CREEK (MAIN BRANCH)	17/11/70	2.5	830	5	825	436	9,100	<0.01	0.60	0.004	0.63	0.85	0.70
LY-3.5	LYNDE CREEK (MAIN BRANCH) JUST NORTH OF HWY 2	17/11/70	1.6	380	5	375	68	88	<0.01	0.35	0.006	0.45	0.014	0.007
LY-3.9	LYNDE CREEK (MAIN BRANCH) ABOVE CONFLUENCE WITH EAST BRANCH OF LYNDE CREEK	17/11/70	1.6	380	5	375	36	44	<0.01	0.32	0.007	0.47	0.022	0.010
LY-4.8	LYNDE CREEK (MAIN BRANCH) AT ROSSLAND ROAD WEST	17/11/70	1.0	370	5	365	112	124	0.01	0.40	0.006	0.51	0.016	0.007
LY-6.2	LYNDE CREEK (MAIN BRANCH) AT TAUNTON ROAD	17/11/70	0.6	360	5	355	32	48	0.04	0.39	0.009	0.51	0.020	0.011
LY-7.8	LYNDE CREEK (MAIN BRANCH) AT ROAD BETWEEN CONC IV AND CONC V	17/11/70	2.5	380	5	375	16	36	0.06	0.42	0.006	0.49	0.032	0.015
LY-9.5	LYNDE CREEK (MAIN BR) AT HWY 7, LOT 29	17/11/70	2.0	420	5	415	32	56	0.02	0.42	0.008	0.35	0.038	0.034

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	TOTAL	SUSP	DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTEROA PER 100 ML FECAL	TOTAL	NITROGEN AS N NH3	TOTAL KJELDAHL	NO2	NO3	PHOSPHORUS AS P TOTAL	SOLUBLE
LY-9.9	TRIBUTARY OF LYNDE CREEK (MAIN BRANCH) AT HWY. 7, LOT 28	17/11/70	2.5	490	5	485	404	2,800	0.05	0.88	0.012	0.40	0.095	0.020
LY-12.3	LYNDE CREEK (MAIN BRANCH) AT THE 8TH CONCESSION ROAD	17/11/70	1.8	400	5	395	4	24	<0.01	0.37	0.002	0.01	0.008	0.004
LYD-9.6	DAGMAR TRIBUTARY OF LYNDE CREEK (MAIN BRANCH) AT HWY 7, LOT 32	17/11/70	1.6	350	5	345	56	112	<0.01	0.31	0.004	0.53	0.012	0.009
LYD-10.9	DAGMAR TRIBUTARY OF LYNDE CREEK (MAIN BRANCH) AT THE 7TH CONCESSION ROAD	17/11/70	1.6	350	5	345	124	236	0.02	0.25	0.004	0.60	0.012	0.007
LYD-12.4	DAGMAR TRIBUTARY OF LYNDE CREEK (MAIN BRANCH) AT THE 8TH CONCESSION ROAD	17/11/70	0.8	320	5	315	84	112	0.03	0.25	0.004	0.74	0.012	0.006
LYD-13.8	DAGMAR TRIBUTARY OF LYNDE CREEK AT COUNTY ROAD 5	17/11/70	1.4	300	5	295	336	620	0.10	0.43	0.008	0.76	0.022	0.010

All analyses in ppm except where indicated

Town of Whitby

Water Pollution Survey

Lynde Creek (East Branch)
Samples Collected by: D. Camero
J. Clarke

Table II (b)

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N TOTAL KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
LYE-3.9	LYNDE CREEK (EAST BRANCH) ABOVE CONFLUENCE WITH LYNDE CREEK (MAIN BRANCH)	17/11/70	2.5	380	5	375	12	64	0.02	0.32	0.005	0.41	0.018	0.006
LYE-5.2	LYNDE CREEK (EAST BRANCH) AT ROSSLAND ROAD WEST	17/11/70	2.0	400	5	395	124	188	0.01	0.34	0.007	0.45	0.020	0.007
LYE-6.6	LYNDE CREEK (EAST BRANCH) AT TAUNTON ROAD	17/11/70	1.2	410	5	405	48	256	<0.01	0.37	0.006	0.49	0.020	0.007
LYE-8.5W	DRAINAGE PIPE JUST BELOW OLD DUMP SITE	19/11/70	6.5	1,880	10	1,870	<4	8						
	HARDNESS (CACO3) - 440	CHLORIDE (CL) - 847												
	ALKALINITY (CACO3) - 299	SODIUM (NA) - 530												
	IRON (FE) - 0.9	POTASSIUM (K) - 147												
	MANGANESE (MN) - 0.03	CALCIUM (CA) - 139												
	PH AT LAB - 7.7													
LYE-8.55	LYNDE CREEK (EAST BRANCH) BELOW OLD DUMP SITE	17/11/70	1.0	340	5	335	196	296	<0.01	0.33	0.007	0.49	0.30	0.012
		19/11/70	1.4	350	10	340	192	900						
	HARDNESS (CACO3) - 264	CHLORIDE (CL) - 19												
	ALKALINITY (CACO3) - 222	SODIUM (NA) - 8												
	IRON (FE) - 0.2	POTASSIUM (K) - 0.2												
	MANGANESE (MN) - 0.0	CALCIUM (CA) - 83												
	PH AT LAB - 8.2													
LYE-10.4	LYNDE CREEK (EAST BRANCH) DOWNSTREAM OF WINCHESTER ROAD	23/11/70	0.8	400	<15	--	600	3,600	0.05	0.47	0.02	1.0	0.056	0.35
LYE-10.5W(W)	STORM SEWER OUTFALL TO WEST SIDE OF LYNDE CREEK (EAST BRANCH) AT WINCHESTER RD	17/11/70	11.0	1,220	5	1,215	18,400	210,000	2.0	3.30	0.68	7.2	1.8	1.1
		23/11/70	3.0	1,170	<15	--	660,000	1,400,000	1.7	0.30	3.40	5.6	0.86	0.65

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N TOTAL KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
LYE-10.5W(E)	STORM SEWER OUTFALL TO EAST SIDE OF LYNDE CREEK (EAST BRANCH) AT WINCHESTER	17/11/70	100.0	840	40	800	8,000	65,000	4.7	8.4	0.72	4.7	7.0	2.7
		23/11/70	3.5	850	<15	--	13,700	34,000	1.5	1.6	5.0	5.0	1.5	0.80
LYE-10.55	LYNDE CREEK (EAST BRANCH) UPSTREAM OF WINCHESTER ROAD	17/11/70	2.5	370	5	365	252	508	0.03	0.36	0.009	0.58	0.048	0.040
		23/11/70	0.8	380	<15	--	460	1,708	0.04	0.42	0.013	0.93	0.030	0.020
LYE-10.7W	STORM SEWER OUTFALL AT CASSELS ROAD EAST	17/11/70	13.0	760	10	750	17,100	102,000	3.3	6.3	0.45	3.9	2.0	1.5
		23/11/70	50.0	930	50	880	6,500,000	33,000,000	2.2	2.4	1.3	5.1	2.2	1.7
LYE-10.85	LYNDE CREEK (EAST BRANCH) DOWNSTREAM OF HWY 12 IN BROOKLIN	23/11/70	0.6	380	<15	--	272	3,500	0.01	0.59	0.020	0.84	0.64	0.055
LYE-10.9W	STORM SEWER OUTFALL ON WEST SIDE OF HWY 12 IN BROOKLIN	17/11/70	50.0	810	40	770	490,000	610,000	0.37	4.0	1.7	5.5	10.0	1.6
		23/11/70	300.0	1,830	390	1,440	239,000	78,000,000	1.6	3.0	0.13	14.0	1.8	0.8
LYE-11.0	LYNDE CREEK (EAST BRANCH) DOWNSTREAM OF WAY ROAD SOUTH BRIDGE	17/11/70	1.4	370	5	365	124	188	0.03	0.39	0.012	0.75	0.054	0.038
LYE-11.2W	STORM SEWER OUTFALL BEHIND WATER WORKS	23/11/70	1.4	770	<15	--	8,800	14,400	0.15	0.54	0.12	11.0	0.39	0.32
LYE-11.3	LYNDE CREEK (EAST BRANCH) AT WAY ROAD NORTH BRIDGE	23/11/70	0.6	390	<15	--	196	200	0.03	0.43	0.014	0.89	0.054	0.010
LYE-12.0	LYNDE CREEK (EAST BRANCH) AT THE 7TH CONCESSION RD	17/11/70	1.4	340	5	335	2	120	0.01	0.41	0.004	0.48	0.024	0.12
		23/11/70	0.8	360	<15	--	116	268	0.03	0.44	0.006	0.89	0.026	0.012

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N TOTAL KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
LYEE-13.5	EAST TRIBUTARY OF LYNDE CREEK (EAST BRANCH) AT THE 8TH CONCESSION ROAD	17/11/70	1.0	330	5	325	28	84	<0.01	0.22	0.002	0.72	0.012	0.009
LYEE-16.0	EAST TRIBUTARY OF LYNDE CREEK (EAST BRANCH) AT WHITBY - REACH TWP ROAD	17/11/70	1.2	320	5	315	<4	20	0.02	0.24	0.014	0.36	0.026	0.026
LYE-13.9	LYNDE CREEK (EAST BRANCH) AT COUNTY ROAD 5A	17/11/70	2.5	330	5	325	72	7,300	0.05	0.50	0.006	0.31	0.090	0.038
LYEA-14.6	ASHBURN TRIBUTARY OF LYNDE CREEK (EAST BRANCH) BELOW THE COMMUNITY OF ASHBURN	17/11/70	1.8	440	5	435	540	760	0.07	0.66	0.013	0.34	0.054	0.018
		23/11/70	0.6	410	<15	—	363	2,200	0.06	0.73	0.014	0.94	0.060	0.031
LYEA-15.0	ASHBURN TRIBUTARY OF LYNDE CREEK (EAST BRANCH) AT COUNTY ROAD 5	17/11/70	1.8	420	5	415	640	830	0.10	0.76	0.008	0.31	0.068	0.020
		23/11/70	0.8	410	<15	—	500	1,300	0.06	0.70	0.012	0.92	0.056	0.016
LYE-15.3	LYNDE CREEK (EAST BRANCH) AT COUNTY ROAD 5	17/11/70	0.8	340	5	335	12	28	0.02	0.33	0.003	0.05	0.028	0.010
LYE-16.7	LYNDE CREEK (EAST BRANCH) AT WHITBY - REACH TWP ROAD	17/11/70	2.0	340	5	235	*—	*—	0.08	0.66	0.008	0.05	0.046	0.010

* Sample destroyed in laboratory accident

All analyses in ppm except where indicated

Town of Whitby

Water Pollution Survey

Table II(c)

Lynde Creek (West Branch)
Samples Collected by: D. Cameron
J. Clarke

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N TOTAL KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
LYW-1.5	LYNDE CREEK (WEST BRANCH) AT VICTORIA STREET WEST	17/11/70	2.0	300	10	390	372	1,100	0.06	0.65	0.010	0.50	0.064	0.026
LYW-2.9	LYNDE CREEK (WEST BRANCH) AT HWY 2	17/11/70	3.0	360	10	350	136	2,700	0.07	0.80	0.009	0.43	0.11	0.042
LYWW-4.3	TRIBUTARY TO LYNDE CREEK (WEST BRANCH) AT ROSSLAND ROAD WEST	17/11/70	2.0	370	5	365	300	504	0.03	0.54	0.005	0.19	0.058	0.029
LYW-4.3	LYNDE CREEK (WEST BRANCH) AT ROSSLAND ROAD WEST	17/11/70	2.5	390	5	385	470	1,100	0.02	0.31	0.009	0.65	0.024	0.010
LYW-5.6	LYNDE CREEK (WEST BRANCH) AT TAUNTON ROAD	17/11/70	0.6	360	5	355	108	172	0.04	0.47	0.007	0.69	0.020	0.007
LYW-6.9	LYNDE CREEK (WEST BRANCH) AT ROAD BETWEEN CONC IV AND CONC V	17/11/70	1.4	440	5	435	24	84	<0.01	0.39	0.002	0.30	0.008	0.006

All analyses reported in ppm except where indicated

Town of Whitby

Water Pollution Survey

Table III

Corbett Creek
Samples Collected by:
D. Cameron

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS			BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML		NITROGEN AS N				PHOSPHORUS AS P	
				TOTAL	SUSP	DISS	FECAL	TOTAL	NH3	TOTAL KJELDAHL	NO2	NO3	TOTAL	SOLUBLE
COR-1.0	CORBETT CREEK AT THICKSON ROAD SOUTH OF LASCO	25/11/70	1.0	740	5	735	10	60	0.02	1.0	0.006	0.35	0.040	0.004
COR-2.8	CORBETT CREEK AT THICKSON ROAD JUST SOUTH OF WHITBY MALL	25/11/70	1.8	760	10	750	120	600	0.08	1.1	0.010	0.09	0.12	0.018
COR-3.0W	STORM SEWER OUTFALL FROM WHITBY MALL	25/11/70	5.5	1,080	160	920	1,100	2,800	0.11	1.6	0.032	0.83	0.070	0.004
COR-3.3	CORBETT CREEK AT HWY 2	25/11/70	1.0	680	5	675	20	60	0.04	0.78	0.009	0.09	0.048	0.022
COR-3.8	CORBETT CREEK AT MANNING ROAD	25/11/70	0.4	660	5	655	100	124	0.09	0.34	0.020	2.7	0.061	0.014

All analyses in ppm
except where indicated

Town of Whitby

Water Pollution Survey

Table IV

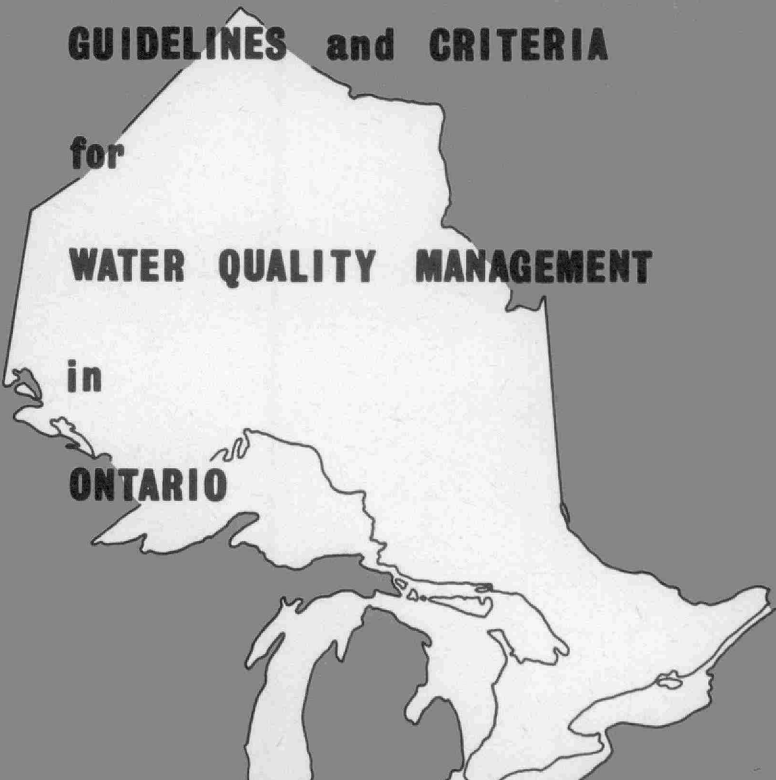
Lake Ontario and Whitby Harbour
Samples Collected by: D. Cameron
J. Clarke

SAMPLING POINT NO	LOCATION	DATE	5-DAY BOD	SOLIDS TOTAL	SOLIDS SUSP	SOLIDS DISS	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML FECAL	BACTERIOLOGICAL EXAMINATION COLIFORM BACTERIA PER 100 ML TOTAL	NITROGEN AS N NH3	NITROGEN AS N KJELDAHL	NITROGEN AS N NO2	NITROGEN AS N NO3	PHOSPHORUS AS P TOTAL	PHOSPHORUS AS P SOLUBLE
L.ONT-1	LYNDE CREEK AT MOUTH	17/11/70	2.0	330	5	325	48	124	0.07	0.54	0.015	0.36	0.048	0.020
		18/11/70	2.0	330	5	295	32	12	0.03	0.47	0.013	0.38	0.034	0.012
L.ONT-2T	ONTARIO HOSPITAL STP EFFLUENT	18/11/70	8.0	440	10	430	10	110	0.33	2.0	0.021	15.0	10.0	9.5
		23/11/70	3.0	430	<15	--	16	32	0.05	0.90	0.005	14.0	7.7	0.82
L.ONT-3	LAKE ONTARIO - MID-POINT ONTARIO HOSPITAL BEACH	18/11/70	1.2	540	340	200	48	216	0.01	0.34	0.009	0.16	0.039	0.027
L.ONT-4	LAKE ONTARIO - EAST END ONTARIO HOSPITAL BEACH	18/11/70	2.5	230	10	220	60	344	0.01	0.45	0.014	0.59	0.18	0.097
W.H.-1W	STORM SEWER OUTFALL FROM ONTARIO HOSPITAL COMPLEX TO WHITBY HARBOUR	18/11/70	0.4	550	5	545	4	112	<0.01	0.74	0.01	3.7	0.3	0.18
		23/11/70	0.4	760	<15	--	4	104	0.02	0.32	0.009	9.8	12.0	0.14
W.H.-2	WHITBY HARBOUR WEST SIDE NEAR YACHT CLUB	18/11/70	4.0	540	15	505	<4	220	0.33	1.4	0.05	9.4	3.0	2.7
PR-0.8	PRINGLE CREEK AT BROCK STREET SOUTH	23/11/70	1.2	610	<15	--	4	16	0.27	1.0	0.021	6.5	1.8	1.8
L.ONT-5	LAKE ONTARIO. WHITBY HARBOUR AT EAST PIER	18/11/70	1.4	240	10	230	36	160	0.04	0.51	0.008	0.45	0.13	0.076
L.ONT-6	LAKE ONTARIO - BEACH AREA JUST EAST OF WATER WORKS	18/11/70	1.6	540	--	--	12	44	<0.01	0.48	0.005	0.11	0.19	0.009
L.ONT-7	LAKE ONTARIO - BEACH AREA EXTREME EAST END, EAST OF WATER WORKS	18/11/70	2.5	380	15	365	4	44	<0.01	0.51	0.005	0.12	0.14	0.018

Water management in Ontario

Ontario
Water Resources
Commission

June
1970



GUIDELINES and CRITERIA for WATER QUALITY MANAGEMENT in ONTARIO

GUIDELINES AND CRITERIA

FOR

WATER QUALITY MANAGEMENT IN ONTARIO

BY THE

ONTARIO WATER RESOURCES COMMISSION

HON. G. A. KERR, Q.C.
Minister

J. H. H. ROOT, M.P.P.
Vice-Chairman

D. J. COLLINS,
Chairman

135 St. Clair Avenue W., Toronto 7, Ontario
June, 1970

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LIST OF TABLES

INTRODUCTION

In 1967, the Ontario Water Resources Commission announced its Policy Guidelines for Water Quality Control in the Province of Ontario. This publication contains a re-statement of the guidelines and introduces water quality criteria for various uses including public, agricultural and industrial water supply, recreation, aesthetic enjoyment and the propagation of fish and wildlife. The use of water for assimilation and dilution of treated wastes must take into consideration these many desirable uses. Application of the criteria to water uses within the drainage basins of the province, or parts thereof, will lead to the development of water quality standards for the control of water pollution.

GUIDELINES FOR THE CONTROL OF WATER QUALITY

1 The water resources of Ontario must meet many needs, some of which are in conflict. The standards established, therefore, must be based on the best interests of the people of Ontario. These interests require the preservation, and restoration where necessary, of the quality of our water for the greatest number of uses. The use of water for the assimilation and dilution of treated waste effluents must take into consideration the variety of uses, including public, agricultural and industrial supply, recreation, aesthetic enjoyment and the propagation of fish and wildlife.

2 For each use of water there are certain water quality characteristics, identified as criteria, which should be met to ensure that the water is suitable for that use.

3 Water quality standards will be established by the Ontario Water Resources Commission for waters of drainage basins or parts thereof with important water uses, following consultation with agencies or persons having an interest or responsibility in the present or future use of the water in the basin for which the standards are to be established.

4 Water of a higher quality than that required by the standards will be maintained at that higher quality unless in the public interest an alteration of the quality is consistent with the protection of all uses which are in accordance with the water quality standards established.

There should be a constant effort to improve the quality of water, for it is recognized that the improvement of the quality of water makes it available for more uses.

5 Requirements for effluents and land drainage based on the applicable water quality standards, or criteria where such standards do not exist, will be established by the Commission in order to maintain acceptable water quality. More stringent methods of control and/or treatment of waste inputs and land drainage may become necessary as the use of water changes or increases, or as standards are re-defined.

6 In establishing effluent requirements from water quality standards a reserve capacity of the receiving water should be set aside to provide an adequate margin of protection in recognition of the limitations of water management theory and practice.

7 All wastes prior to discharge to any receiving watercourse must receive the best practicable treatment or control. Such treatment must be adequate to protect and wherever possible upgrade water quality in the face of population and industrial growth, urbanization and technological change.

8 Criteria and standards of water quality and effluent requirements will be defined quantitatively only where sound numerical information is available; otherwise, they will be described in appropriate detail. They will be re-defined from time to time in the light of new evidence.

WATER QUALITY CRITERIA

The following criteria for water quality are a set of numerical and descriptive characteristics, carefully defined, and applicable to each major water use category such as agriculture; fish, other aquatic life and wildlife; industrial water supply; public water supply; recreation and aesthetics. The criteria are described for use in establishing Water Quality Standards for drainage basins which in turn will be used to determine Effluent Requirements for discharges of wastes and land drainage.

The responsibility for demonstrating that a waste effluent is harmless to water uses in the concentrations to be found in the receiving waters, rests with those producing the discharge. Zones of passage and/or mixing adjacent to outfalls at the limit of which water quality may be critical, will be prescribed by the Commission.

Reference is frequently made in the Criteria to the Report of the Committee on Water Quality, Federal Water Pollution Control Administration, U.S. Department of the Interior (1968). Acknowledgement of the report is gratefully given in recognition of its basic reference value.

ZONES OF PASSAGE AND MIXING

Mixing zones in the vicinity of outfalls should be restricted as much as possible in extent and should provide for the safe passage of both fish and free-floating and drift organisms. Every precaution should be taken to ensure that at least two-thirds of the total cross-sectional area of a river or stream is characterized by a quality which is entirely favourable to the aquatic community at all times. In most cases this would preclude the use of a diffuser outfall which would distribute effluent uniformly across the river or stream. The water quality standard which defines the acceptable concentration of a substance contained in a waste discharge will apply at the periphery of the mixing zone or other specified sampling location.

Within mixing zones, it should be recognized that toxic wastes which will not evoke an avoidance response on the part of fish or other organisms should not be permitted. Where toxic materials are being discharged it should be assumed that the various components in the waste, regardless of the form in which they are present, may eventually be altered to the most toxic form in the aquatic environment. Adequate treatment of all wastes should be provided and mixing zones should not be considered as a substitute for proper treatment.

STATISTICAL PROBLEMS IN SETTING LIMITS

The systematic surveillance of water and waste sources requires the collection of data to clearly represent the problems being studied. The problems are many and varied. In one case the average condition over a period of time may be required and the question arises over what period shall the average or median be taken; in another, the limit may be a figure that should not be exceeded at any time. If a standard for a certain constituent is "none", the question arises "how small an amount does this mean?" The answers vary with the type of standard and the circumstances governing the fluctuation of the indicator. In ground water problems, only the average over a considerable period of time is significant. Where required in the setting of standards and effluent requirements, definitions of limits will include the applicable sampling conditions, quantitative values and rates of discharge.

1 WATER QUALITY CRITERIA FOR AGRICULTURAL USES (AGR)

Agricultural production requires water of suitable quality for a variety of uses. Criteria for the major uses are given under three headings: Dairy Sanitation, Livestock Watering, and Irrigation.

Requirements for domestic and other farmstead uses and the common requirements for dairy sanitation are given elsewhere in the criteria for Private Water Supplies and Public Water Supplies.

AGR-1 Dairy Sanitation

Modern methods for bulk handling of milk on farms require large volumes of good quality water to ensure a premium product. The quality of water needed for good dairy sanitation requires criteria for certain parameters that are additional to, or more stringent than, those required for private water supplies. These are summarized under the headings "Permissible Criteria" and "Desirable Criteria". They should be used in conjunction with the criteria for public and private water supplies.

Treatment may prove satisfactory in meeting the criteria for certain of the inorganic chemicals such as iron and total hardness.

Waters that meet the desirable microbiological criteria can be used without disinfection; those meeting the permissible criteria require disinfection (chlorination), or chlorination and filtration, before use to reduce bacteria to levels where they will not cause deterioration of the quality of milk. Waters used for dairy sanitation should be sampled and tested at least monthly, in some cases daily, to ensure that they meet the microbiological criteria.

TABLE AGR-1

Water Quality Criteria for Agricultural Uses
Dairy Sanitation

Constituent or Characteristic	Permissible Criteria	Desirable Criteria
Inorganic Chemicals:		
Copper	0.1 mg/l	
Iron	0.1 mg/l	
pH (range)	6.8 to 8.5	
Potassium	20 mg/l	
Total hardness as $CaCO_3$	150 mg/l	100 mg/l
Microbiological:		
Proteolytic and/or Lipolytic bacteria (20°C) (individual results)	500/100 ml	0/100 ml
Yeast		Absent
Mould		Absent
Physical:		Clear Colourless Good taste

AGR-2 Livestock Watering

The health and productivity of livestock are affected by the quantities of various substances ingested as feed and as water. Accordingly, the amounts of certain substances that can be present without harm in water consumed by livestock will depend in part on the amounts of the same substances that are present in the feed in addition to a number of other factors which include: the daily water requirements and the species, age, and physiological condition of the animals, and the nature and quantities of other constituents of the feed and water.

Animals may be able to tolerate a fairly high level of total dissolved solids or bacteria if they are accustomed to such levels, but may be unable to tolerate a sudden change from waters with low dissolved solids or bacteria to waters with high dissolved solids or bacteria.

In addition to direct effects on the animals, certain substances may contaminate animal products to the point where they will not be acceptable for human consumption.

The variability of the factors that influence the acceptability of water for livestock-watering purposes must be considered when using the water quality criteria. Although the criteria provide a general guide to the quality of water that will be acceptable for most livestock, there may be cases where water of different quality than that indicated by the criteria will be required or acceptable because of the nature, age, or condition of species being raised or because of special rearing conditions or feed components. In such cases, or where the quality of an individual supply is in doubt, the quality should be assessed in relation to the specific use.

Water meeting the permissible criteria will be satisfactory for most livestock under normal rearing conditions. Water meeting the desirable criteria should provide a palatable and safe source for all normal livestock-watering purposes.

TABLE AGR-2
Water Quality Criteria for Agricultural Uses
Livestock

Constituent or Characteristic	Permissible Criteria	Desirable Criteria
General Quality		ideally should meet the desirable criteria for private water supplies.
Inorganic Chemicals:		
Total Dissolved Solids	2500 mg/l	< 500 mg/l
Arsenic	0.05 mg/l	Absent
Cadmium	0.01 mg/l	Absent
Chromium (hexavalent)	0.05 mg/l	Absent
Fluoride	2.4 mg/l	1.2 mg/l
Lead	0.05 mg/l	Absent
Nitrate plus Nitrite (as N)	20 mg/l	< 10 mg/l
Selenium	0.01 mg/l	Absent
Sulphate	1000 mg/l	< 250 mg/l
Radioactivity:		
Radium-226	3 pc/l	< 1 pc/l
Strontium-90	10 pc/l	< 2 pc/l
Gross beta activity in the known absence of strontium-90 and alpha-emitting radionuclides.	1000 pc/l	< 100 pc/l
Microbiological: (1)		
Enterococci (35°C)	< 40/100 ml	0/100 ml
Algae	No heavy growth of blue-green algae	

(1) The supply should be free of barnyard runoff and of effluent contamination from either man or animals. The geometric mean of sample results should not exceed the values given.

AGR-3 Irrigation

The suitability of water for irrigation cannot be defined precisely because the effects of the water on the crop being irrigated depend on many factors. These include: soil types, climatic conditions, irrigation practices, variations in the relation between the concentration and composition of the irrigation water and the soil solution, variations in the tolerance of different plants to the combined or individual constituents in the irrigation water or the soil solution, and the modifying effects of interrelations between and among the constituents. In general, for satisfactory irrigation, soils with poor drainage characteristics require water of higher quality than better drained soils.

In humid areas, excessive concentrations of salts or individual elements will normally be leached from the soil during periods of heavy rainfall or snowmelt before or after the growing season. This leaching action is another factor affecting the quality of water that can be used for irrigation. It may allow the use of water of poorer quality than that listed in these criteria for some crops and conditions without serious detrimental effects. Also through proper timing and adjustment of frequency and volumes of water applied, detrimental effects of poorer quality water may often be mitigated. Good drainage of soil may be a factor of similar importance as the quality of the water used.

The presence of sediment, pesticides, or pathogenic organisms in irrigation water, which may not specifically affect plant growth, may affect the acceptability of the product. Larger sediment particles could lead to plugging of sprinkler nozzles.

Although there are many variations in the quality of water that is suitable for specific irrigation uses, water quality criteria have been assembled as a guide to the quality of water that will meet many irrigation needs. The criteria are listed as permissible and desirable. Water meeting the desirable criteria should be satisfactory for irrigation of most crops in most soil types for long periods of time. Water meeting the permissible criteria, while suitable for many crops, soil and climatic conditions, could result in decreased yields for some crops if it is used repeatedly, unless there is dilution or leaching by precipitation or the application of excess irrigation water under favourable drainage conditions. Special crops or conditions, such as the growing of plants in greenhouses, may require irrigation with water of higher quality than that indicated by the desirable criteria.

The suitability of a given source of water for specific crops, soil types, and climatic conditions should be judged on an individual basis if its suitability has not been demonstrated by practice.

TABLE AGR-3

Water Quality Criteria for Agricultural Uses

Irrigation

Constituent or Characteristic	**Permissible Criteria**	**Desirable Criteria**
Physical:		
Temperature		55°F to 85°F
Microbiological: (1)		
Fecal Coliforms (44.5°C)	100/100 ml	0/100 ml
Enterococci (35°C)	20/100 ml	0/100 ml
Total bacteria (20°C)	100,000/100 ml	< 10,000/100 ml
Inorganic Chemicals:		
Aluminum	20.0 mg/l	< 1.0 mg/l
Arsenic	10.0 mg/l	< 1.0 mg/l
Beryllium	1.0 mg/l	< 0.5 mg/l
Boron	0.5 mg/l	0.3 mg/l
Cadmium	0.05 mg/l	< 0.005 mg/l
Chloride	150 mg/l	< 70 mg/l
Chloride—special requirement for tobacco	70 mg/l	< 20 mg/l
Chromium	20.0 mg/l	< 5.0 mg/l
Cobalt	10.0 mg/l	< 0.2 mg/l
Copper	5.0 mg/l	< 0.2 mg/l
Lead	20.0 mg/l	< 5.0 mg/l
Lithium	5.0 mg/l	< 5.0 mg/l
Manganese	20.0 mg/l	< 2.0 mg/l
Molybdenum	0.05 mg/l	< 0.005 mg/l
Nickel	2.0 mg/l	< 0.5 mg/l
pH (range)	4.8 to 9.0	
Residual Sodium Carbonate $=(CO_3^{--}+HCO_3^{-})-(Ca^{++}+Mg^{++})$ expressed as mg eq/l	1.25 mg eq/l	< 1.25 mg eq/l
Selenium	0.05 mg/l	< 0.05 mg/l
Sodium Adsorption Ratio $= \dfrac{Na^{+}}{\sqrt{\dfrac{Ca^{++}+Mg^{++}}{2}}}$ expressed as mg eq/l	6	< 4
Total dissolved solids	500 mg/l	< 200 mg/l
Vanadium	10.0 mg/l	< 10.0 mg/l
Zinc	5.0 mg/l	< 5.0 mg/l
Organic Chemicals:		
Pesticides	Insecticides, herbicides, fungicides, and rodenticides must not be present in waters used for irrigation in concentrations that are detrimental to crops, livestock, wildlife or man.	Absent

(1) The geometric mean of sample results should not exceed the values given.

2 WATER QUALITY CRITERIA FOR THE PROTECTION OF FISH, OTHER AQUATIC LIFE AND WILDLIFE (F & W)

The following criteria are considered to be satisfactory for fish, other aquatic life and wildlife. Reference is made to aspects of water quality considered to be most important in the light of current knowledge. Narrative guidelines are offered where quantification is not yet possible.

Dissolved Materials

Dissolved materials should not be added to increase the concentration of dissolved solids by more than one-third of the natural condition of the receiving water, owing to potentially harmful osmotic effects of high concentrations. Dissolved materials that are harmful in relatively low concentrations are discussed in the section "Toxic Substances".

pH, Alkalinity, Acidity

(1) pH should be maintained within a range of 6.5 to 8.5.

(2) To protect the carbonate system, and thus the productivity of the water, acid should not be added in sufficient quantity to lower the total alkalinity to less than 20 mg/l.

Temperature

(1) General

Unless a special study shows that discharge of a heated effluent into the hypolimnion of a lake will be desirable, such practice is not recommended and water for cooling should not be pumped from the hypolimnion to be discharged to the same body of water.

The normal daily and seasonal temperature variations that were present before the addition of heat due to other than natural causes should be maintained.

Wherever possible, heated discharges should be located where elevated temperature will enhance public utilization of the water by supporting a wider variety of water uses.

(2) Great Lakes and Connecting Waters

(a) Heated discharges are not permitted that may stimulate production of nuisance organisms or vegetation or that are or may become injurious to wildlife, waterfowl, fish or other aquatic life or the growth and reproduction thereof. For each discharge of a heated effluent, acceptable mixing zones will be established on the basis of features and facts pertinent to that specific situation.

(b) Heat may not be discharged in the vicinity of spawning areas or where increased water temperature might interfere with recognized movements of spawning or migrating fish populations.

(3) Inland Waters

(a) Heated discharges to inland waters will not be permitted unless it is clearly demonstrated that heated effluents will enhance the usefulness of the water resource without endangering the production and optimum maintenance of wildlife, fish and other aquatic species. It shall be the responsibility of the user to provide evidence to support the acceptability of the discharge under these terms.

(b) Inland trout streams, salmon streams, trout and salmon lakes and the hypolimnion of lakes and reservoirs containing salmonids and other cold water forms should not be warmed.

(c) Heat may not be discharged in the vicinity of spawning areas or where increased temperature might interfere with recognized movements of spawning or migrating fish populations.

Dissolved Oxygen

(1) Warm-water Biota

The dissolved oxygen (DO) concentration should be above 5 mg/l at all times, except that in certain situations concentrations may range between 5 and 4 mg/l for short intervals within any 24-hour period provided that water quality is favourable in all other respects.

(2) Cold-water Biota

In spawning areas, DO levels must not be below 7 mg/l at any time. Elsewhere, DO concentrations should not be below 6 mg/l. In certain situations, they may range between 6 and 5 mg/l for short intervals within any 24-hour period, provided the water quality is favourable in all other respects.

Carbon Dioxide

The 'free' carbon dioxide concentration should not exceed 25 mg/l.

Oil

Oil, petrochemicals or other immiscible substances that will cause visible films or toxic, noxious or nuisance conditions should not be added to water.

Turbidity

(1) Turbidity associated with waste inputs should not exceed 50 Jackson units in warm-water streams or 10 Jackson units in cold-water streams.

(2) There should be no discharge which would cause turbidities exceeding 25 Jackson units in warm-water lakes or 10 Jackson units in cold-water or oligotrophic lakes.

Settleable Materials

Substances should not be added that will adversely affect the aquatic biota or will create objectionable deposits on the bottom or shore of any body of water.

Colour and Transparency

For effective photosynthetic production of oxygen, it is required that 10 per cent of the incident light reach the bottom of any desired photosynthetic zone in which adequate dissolved oxygen concentrations are to be maintained.

Floating Materials

All floating materials, other than those of natural origin, should be excluded from streams and lakes.

Tainting substances

All materials that will impart odour or taste to fish or edible invertebrates should be excluded from receiving waters at levels that produce tainting.

Radionuclides

Radioactive materials should not be present in natural waters as a consequence of failure to exercise necessary controls of radioactivity releases to keep exposure to a minimum.

Experience has shown that standards established for drinking water assure that people will receive no more than currently acceptable amounts of radioactive materials from aquatic sources and that fish and other aquatic life will not receive an injurious dose of radiation.

Thus, present standards accepted for the protection of fish and other aquatic life are as follows:

	pc/l
Gross beta emitters	1000
Radium-226	3
Strontium-90	10

Where other radioisotopes occur, the significance of the exposure of aquatic species to these forms of radiation should be assessed for each situation, both with respect to potential damage to the organisms themselves and to humans where fish or other edible forms are utilized.

Plant Nutrients and Nuisance Growths

(1) Nutrients from unnatural sources that will stimulate production of algae, nuisance vegetation or offensive slime growths should not be added to water. The addition of sulphates or manganese oxide to a lake should be limited if iron is present in the hypolimnion as these substances may increase the quantity of available phosphorus.

(2) Organic or other materials that will promote an increased zone of anaerobic decomposition within a lake, reservoir or other body of water should not be allowed to enter the water.

(3) The naturally-occurring ratios of nitrogen (particularly NO_3 and NH_4) to total phosphorus, and their amounts, should not be radically changed by the addition of materials from waste sources and land drainage.

Toxic Substances

Toxic substances must not be added to water in concentrations or combinations that are toxic or harmful to human, animal, plant or aquatic life, except where the application of approved substances for the control of nuisance organisms has been authorized by the Commission (Section 28b, OWRC Act).

The evaluation of toxicity for aquatic organisms is based on use of the TLm or median tolerance limit. This represents the concentration at which half the test organisms will succumb over a given period of exposure such as 24, 48 or 96 hours. It does not, therefore, represent the safe concentration and an application factor is applied to ensure a safe condition, including allowance for sub-lethal effects.

(1) **Substances of Unknown Toxicity**

All effluents containing foreign materials should be considered harmful and not permissible until bioassay tests have shown otherwise. The onus for demonstrating that an effluent is harmless in the concentrations to be found in the receiving waters rests with those responsible for the discharge. Information concerning acceptable bioassay procedures is available from the Commission.

(2) **Application Factors**

Concentration of materials that are non-persistent (that is, have a half-life of less than 96 hours), or have non-cumulative effects after mixing with the receiving waters, should not exceed 1/10 of the applicable 96-hour TLm value at any time or place based on species representative of local conditions. The 24-hour average of the concentration of these materials should not exceed 1/20 of the TLm value after mixing. For other toxicants, the concentrations should not exceed 1/20 and 1/100 of the TLm value under the aforementioned conditions.

(3) **Additive Effects**

When two or more toxic materials that have additive effects are present at the same time in the receiving water, some reduction is necessary in the permissible concentrations as derived from bioassays on individual substances or wastes. The amount of reduction required is a function of both the number of toxic materials present and their concentrations in respect to the derived permissible concentration. An appropriate means of assuring that the combined

amounts of the several substances do not exceed a permissible concentration for the mixture is through the use of the following relationship:

$$\left(\frac{C_a}{L_a} + \frac{C_b}{L_b} \ldots + \frac{C_n}{L_n} \leq 1\right)$$

where C_a, C_b, ... C_n are the measured concentrations of the several toxic materials in the water and L_a, L_b, ... L_n are the respective permissible concentration limits derived for the materials on an individual basis. Should the sum of the several fractions exceed one, then a local restriction on the concentration of one or more of the substances is necessary.

(4) **Pesticides**

(a) Chlorinated Hydrocarbons:

Any addition of chlorinated hydrocarbon insecticides is likely to cause damage to some desired organisms and their use should be avoided.

(b) Other Chemical Pesticides:

Other pesticides and herbicides gaining access to water can cause damage to desirable organisms and should be used with utmost discretion and caution. Tables F & W-1 and F & W-2 list the 48-hour TLm values of a number of pesticides for various types of fresh water organisms. To provide reasonably safe concentrations of these materials in receiving waters, application factors ranging from 1/10 to 1/100 should be used, with these values depending on the characteristic of the pesticide in question and used as specified in (2) above. Concentrations thus derived may be considered tentatively safe under the conditions specified. TLm values and related application factors are subject to revision as additional bioassay information is obtained for species which may be more representative of local conditions.

(5) **Other Toxic Substances**

(a) ABS: The concentration of ABS should not exceed 1/7 of the 48-hour TLm at any time or place.

(b) LAS: The concentration of LAS should not exceed 1/7 of the 48-hour TLm at any time or place.

(c) ARSENIC: An application factor of 1/100 should be applied to the 96-hour TLm value as a tentative safe concentration for continuous exposure. An environmental level of .01 mg/l should not be exceeded under any circumstances.

(d) AMMONIA: Permissible concentrations of ammonia should be determined by the flow-through bioassay with the pH of the test solution maintained at 8.5, DO concentrations between 4 and 5 mg/l, and temperatures near the upper allowable levels.

(e) CADMIUM: The concentration of cadmium must not exceed 1/500 of the 96-hour TLm concentration at any time or place.

(f) CHROMIUM: The concentration of chromium should not exceed 1/100 of the 96-hour TLm at any time or place.

(g) COPPER: The maximum copper (expressed as Cu) concentration at any time or place shall not be greater than 1/12 of the 96-hour TLm value. The maximum permissible concentration for continuous exposure is between 3 per cent and 7 per cent of the 96-hour TLm.

(h) LEAD: The concentration of lead should not exceed 1/20 of the 96-hour TLm at any time or place and the 24-hour average should not exceed 1/100 of the 96-hour TLm concentration after mixing.

(i) MERCURY: Owing to demonstrated cumulative effects of mercury in fish, and the attendant hazard to other animals, discharges of mercury to water should be avoided.

(j) NICKEL: The concentration of nickel should not exceed 1/50 of the 96-hour TLm concentration at any time or place.

(k) ZINC: The concentration of zinc should not exceed 1/100 of the 96-hour TLm concentration at any time or place.

TABLE F & W-1 INSECTICIDES*

(48-hour TLm values from static bioassay, in micrograms per litre. Exceptions are noted.)

Pesticide	Stream Invertebrate[1] Species	Stream Invertebrate[1] TLm	Cladocerans[2] Species	Cladocerans[2] TLm	Fish[3] Species	Fish[3] TLm	Gammarus Lacustris,[4] TLm
Abate	Pteronarcys californica	100			Brook trout	1,500	640
Aldrin[5]	P. californica	8	Daphnia pulex.	28	Rainbow trout	3	12,000
Allethrin	P. californica	28	D. pulex	21	- do -	19	20
Azodrin					- do -	7,000	
Aramite			D. magna	345	Bluegill	35	100
Baygon[5]	P. californica	110			Fathead	25	50
Baytex[5]	P. californica	130	Simocephalus serrulatus	3.1	Brown t.	80	70
Benzene hexachloride (lindane)	P. californica	8	D. pulex	460	Rainbow t.	18	88
Bidrin	P. californica	1900	D. pulex	600	- do -	8,000	790
Carbaryl (sevin)	P. californica	1.3	D. pulex	6.4	Brown t.	1,500	22
Carbophenothion (trithion)			D. magna	0.009	Bluegill	225	28
Chlordane[5]	P. californica	55	S. serrulatus	20	Rainbow t.	10	80
Chlorobenzilate			S. serrulatus	550	- do -	710	
Chlorthion			D. magna	4.5			
Coumaphos			D. magna	1			0.14
Cryolite			D. pulex	5,000	Rainbow t.	47,000	
Cyclethrin			D. magna	55			
DDD (TDE)[5]	P. californica	1100	D. pulex	3.2	Rainbow t.	9	1.8
DDT[5]	P. californica	19	D. pulex	0.36	Bass	2.1	2.1
Delnav (dioxathion)					Bluegill	14	690
Delmeton (systex)				14	- do -	81	
Diazinon[5]	P. californica	60	D. pulex	0.9	- do -	30	500
Dibrom (naled)	P. californica	16	D. pulex	3.5	Brook t.	78	160
Dieldrin[5]	P. californica	1.3	D. pulex	240	Bluegill	3.4	1,000
Dilan			D. magna	21	- do -	16	600
Dimethoate (cygon)	P. californica	140	D. magna	2500	- do -	9600	400
Dimethrin					Rainbow t.	700	
Dichlorvos[5] (DDVP)	P. californica	10	D. pulex	0.07	Bluegill	700	1
Disulfoten (di-syston)	P. californica	18			- do -	40	70

* From Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, U.S. Department of the Interior (1968).

TABLE F & W-1—continued

Pesticide	Stream Invertebrate[1] Species	Stream Invertebrate[1] TLm	Cladocerans[2] Species	Cladocerans[2] TLm	Fish[3] Species	Fish[3] TLm	Gammarus Lacustris,[4] TLm
Dursban	Peteronareella badia	1.8			Rainbow t.	20	0.4
Endosulfan (thiodan)	P. californica	5.6	D. magna	240	- do -	1.2	64
Endrin[5]	P. californica	0.8	D. pulex	20	Bluegill	0.2	4.7
EPH			D. magna	0.1	- do -	17	36
Ethion	P. californica	14	D. magna	0.01	- do -	230	3.2
Ethyl guthion[5]			D. pulex		Rainbow t.		
Fenthion	P. californica	39	D. pulex	4			
Guthion[5]	P. californica	8	D. magna	0.2	Rainbow t.	10	0.3
Heptachlor[5]	P. badia	4	D. pulex	42	- do -	9	100
Kelthane (dicofel)	P. californica	3000	D. magna	390	- do -	100	
Kepone					- do -	37.5	
Malathion[5]	P. badia	6	D. pulex	1.8	Brook t.	19.5	1.8
Methoxychlor[5]	P. californica	8	D. pulex	0.8	Rainbow t.	7.2	1.3
Methyl parathion[5]			D. magna	4.8	Bluegill	8000	
Morestan	P. californica	40			- do -	96	
Ovex	P. californica	1500			- do -	700	
Paradichlorobenzene					Rainbow t.	880	
Parathion[5]	P. californica	11	D. pulex	0.4	Bluegill	47	6
Perthane			D. magna	9.4	Rainbow t.	7	
Phosdrin[5]	P. californica	9	D. pulex	0.16	- do -	17	310
Phosphamidon	P. californica	460	D. magna	4	- do -	8000	3.8
Pyrethrins	P. californica	64	D. pulex	25	- do -	54	18
Rotenone	P. californica	900	D. pulex	10	Bluegill	22	350
Strobane[5]	P. californica	7			Rainbow t.	2.5	
Tetradifon (tedion)					Bluegill	1100	140
TEPP[5]					Fathead	390	52
Thanite			D. magna	450			
Thimet					Bluegill	5.5	70
Toxaphene[5]	P. californica	7	D. pulex	15	Rainbow t.	2.8	70
Trichlorofon (dipterex)[5]	P. badia	22	D. magna	8.1	- do -	160	60
Zectran	P. californica	16	D. pulex	10	- do -	8000	76

TABLE F & W-2

HERBICIDES, FUNGICIDES, DEFOLIANTS, ALGICIDES*

Pesticide	Stream Invertebrate[1] Species	Stream Invertebrate[1] TLm	Cladocerans[2] Species	Cladocerans[2] TLm	Fish[3] Species	Fish[3] TLm	Gammarus Lacustris,[4] TLm
Ametryne					Rainbow t.	3400	
Aminotriazole							
Aquathol					Bluegill	257	
Atrazine			Daphnia magna	3600	Rainbow t.	12,600	
Azide, potassium					Bluegill	1400	10,000
Azide, sodium					- do -	980	9000
Copper chloride					- do -	1100	
Copper sulphate					- do -	150	
Dichlobenil	Pteronarcys californica	44,000	Daphnia pulex	3700	- do -	20,000	1500
2,4-D PGBEE			D. pulex	3200	Rainbow t.	960	1800
2,4-D BEE	P. californica	1800			Bluegill	2100	760
2,4-D isopropyl					- do -	800	
2,4-D butyl ester					- do -	1300	
2,4-D butyl + isopropyl ester					- do -	1500	
2,4,5-T isooctyl ester					- do -	16,700	
2,4,5-T isopropyl ester					- do -	1700	
2,4,5-T PGBE					- do -	560	
2(2,4-DP) BEE					- do -	1100	
Dalapon	P. californica Very low toxicity		D. magna	6000		Very Low Toxicity	
Dead-X	P. californica	5000	D. pulex	3700	Rainbow t.	9400	5600
DEF	P. californica	2300			Bluegill	36	230
Dexon	P. californica	42,000			Bluegill	23,000	6000
Dicamba					non-toxic		5800
Dichlone			D. magna	26	Rainbow t.	48	11,500
Difolitan	P. californica	150			Channel Cat	31	6500
Dinitrocresol	P. californica	560			Rainbow t.	210	
Diquat					Rainbow t.	12,300	
Diuron	P. californica	2800	D. pulex	1400	- do -	4300	380
Du-ter					Bluegill	33	
Dyrene			D. magna	490		15	
Endothal, copper					Rainbow t.	290	

* From Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, U.S. Department of the Interior (1968).

TABLE F & W-2—continued

Pesticide	Stream Invertebrate[1] Species	Stream Invertebrate[1] TLm	Cladocerans[2] Species	Cladocerans[2] TLm	Fish[3] Species	Fish[3] TLm	Gammarus Lacustris,[4] TLm
Endothal dimethylamine					Rainbow t.	1150	
Fenac, acid	P. californica	70,000			- do -	16,500	
Fenac, sodium	P. californica	80,000	D. pulex	4500	- do -	7500	18,000
Hydram (molinate)	P. californica	3500			- do -	290	
Hydrothol 191					- do -	690	1000
Lanstan (Korax)					- do -	100	5500
LFN					- do -	79	
Paraquat	P. californica Very low toxicity		D. pulex	3700	Very low toxicity		18,000
Propazine					Rainbow t.	7800	
Silvex, PGBEE			D. pulex	2000	- do -	650	
Silvex, isoctyl					Bluegill	1400	
Silvex, BEE					- do -	1200	
Simazine	P. californica	50,000			Rainbow t.	5000	21,000
Sodium arsenite	P. californica Very low toxicity		Simocephalus serrulatus	1400	- do -	36,500	
Tordon (picloram)					- do -	2500	48,000
Trifuralin	P. californica	4200	D. pulex	240	- do -	11	5600
Vernam[5] (vernolate)					- do -	5900	25,000

1 Stonefly bioassay was done at Denver, Colo., and at Salt Lake City, Utah. Denver tests were in soft water (35 mg/l TDS), non-aerated, 60 F. Salt Lake City tests were in hard water (150 mg/l TDS), aerated, 48-50 F. Response was death.

2 Daphnia pulex and Simocephalus serrulatus bioassay was done at Denver, Colo., in soft water (35 mg/l TDS), non-aerated, 60 F. Daphnia magna bioassay was done at Pennsylvania State University in hard water (146 mg/l TDS), non-aerated, 68 F. Respone was immobilization.

3 Fish bioassay was done at Denver, Colo., and at Rome N.Y. Denver tests were with 2-inch fish in soft water (35 mg/l TDS), non-aerated, trout at 55 F.; other species at 65 F. Rome tests were with 2-2½ inch fish in soft water (6 mg/l TA: pH 5.85-6.4), 60 F. Response was death.

4 Gammarus bioassay was done at Denver, Colo., in soft water (35 mg/l TDS), non-aerated, 60 F. Response was death.

5 Becomes bound to soil when used according to directions, but highly toxic (reflected in numbers) when added directly to water.

3 WATER QUALITY CRITERIA FOR INDUSTRIAL WATER SUPPLIES (IWS)

Desired water quality criteria are tabled for the major industrial classifications as follows:

Brewing and Soft Drinks	— IWS-1
Chemical and Allied Products	— IWS-2
Industrial Cooling	— IWS-3
Food Processing	— IWS-4
Electroplating and Metal Finishing	— IWS-5
Iron and Steel	— IWS-6
Petroleum	— IWS-7
Pulp and Paper	— IWS-8
Leather Tanning and Finishing	— IWS-9
Textiles	— IWS-10

While the values listed should not normally be exceeded, these water quality criteria can vary considerably for the same industrial process depending on factors such as the technological age of plant design.

A raw surface water and/or ground water supply which is used by many different industries may not satisfy the widely varying criteria for each use. However, water treatment technology in its present state of development permits the utilization of surface water of literally any available quality to produce water of any desired quality at the point of use in industry.

Most industries located on municipal water supply systems find the quality of water provided to be satisfactory. If the water quality requirements of an industry are such that water of higher quality than that provided by the municipality is required for specific process use, the industry generally accepts the additional costs involved to produce the higher quality water.

TABLE IWS-1

WATER QUALITY CRITERIA FOR THE BREWING AND SOFT DRINK INDUSTRIES

(Unless otherwise indicated, units are mg/l)

Characteristic	Concentration
Alkalinity ($CaCO_3$)	85
pH, units	[1]
Hardness ($CaCO_3$)	[1]
Chloride (Cl)	250[2]
Sulphate (SO_4)	250[2]
Iron (Fe)	0.3[3]
Manganese (Mn)	0.05
Fluoride (F)	1[3]
Dissolved solids	[1]
Organics: carbon chloroform extract (CCE)	0.15[3]
Coliform bacteria, count/100 ml	[3]
Colour, units	5[4]
Taste, threshold number	[4, 5]
Odour, threshold number	[4, 5]

(1) Controlled by treatment for other constituents.
(2) For brewing, value should not exceed 100 mg/l.
(3) Not greater than OWRC Drinking Water Objectives.
(4) In general, public water supplies are given conventional treatment such as coagulation, filtration and chlorination. Any additional requirement for higher quality, for example, deionized water, is the responsibility of the industry. To ensure low organic content, activated carbon treatment is used by industry.
(5) Zero, not detectable by test.

TABLE IWS-2

WATER QUALITY CRITERIA FOR THE CHEMICAL AND ALLIED PRODUCTS INDUSTRIES*

(Unless otherwise indicated, units are mg/l)

Characteristic	Concentration[1]
Alkalinity (as $CaCO_3$)	150
Iron (Fe)	0.3
Manganese (Mn)	0.1
Calcium (Ca)	50
Magnesium (Mg)	25
Bicarbonate (HCO_3)	250
Sulphate (SO_4)	250
Chloride (Cl)	250
Nitrate (NO_3) as N	10
Hardness (as $CaCO_3$)	250
pH, units	6.5-8.5
Dissolved solids	750
Silica	50
Colour, units	20
Suspended solids	15

* Industries include the manufacture of synthetic rubber, plastics, fertilizers, soap and detergents, organic and inorganic chemicals, etc.
(1) Because of the varying requirements of the many uses in the vast number of chemical industries, more stringent restrictions are placed on several of the above noted characteristics. In some cases, any concentration can be handled, while in others, the raw water is accepted as received provided it meets total solids or other limiting values. The above concentrations are suggested guidelines that should be suitable for the majority of uses in the chemical industry.

TABLE IWS-3

WATER QUALITY CRITERIA FOR COOLING WATER*

(Unless otherwise indicated, units are mg/l)

Characteristic	Concentration
Turbidity	50
Hardness	50
Iron	0.5
Manganese	0.5

- Cooling waters should have appropriate initial temperatures and should not deposit scale, be corrosive or encourage the growth of slimes. Among the constituents of natural water that may prove detrimental to its use for cooling purposes are hardness, suspended solids, dissolved gases, acids, oil and other organic compounds and slime-forming organisms.

TABLE IWS-4

WATER QUALITY CRITERIA FOR THE FOOD PROCESSING INDUSTRY

(Unless otherwise indicated, units are mg/l)

Characteristic	Concentration
Alkalinity ($CaCO_3$)	150
pH, units	6.5-8.5
Hardness ($CaCO_3$)	150
Chloride (Cl)	250
Sulphate (SO_4)	250
Iron (Fe)	0.2
Manganese (Mn)	0.2
Chlorine (Cl)	(1)
Fluoride (F)	1(2)
Silica (SiO_2)	50
Phenol	(3, 4)
Nitrate (NO_3) as N	10(2)
Nitrite (NO_2) as N	(3)
Organics:	
Carbon chloroform extract (CCE)	0.15
Odour, threshold number	(3)
Taste, threshold number	(3)
Turbidity	(6)
Colour, units	5
Dissolved solids	500
Suspended solids	10
Coliform, count/100 ml	(6)
Total bacteria, count/100 ml	(7)

(1) Process waters for food canning are purposely chlorinated to a selected, uniform level. An unchlorinated supply must be available for preparation of canning syrups.

(2) Waters used in the processing and formulation of foods for babies should be low in fluorides concentration. Also, because high nitrate intake is alleged to be involved in infant illnesses, the concentration of nitrates in waters used for processing baby foods should be low.

(3) Zero, not detectable by test.

(4) Because chlorination of food processing waters is a desirable and widespread practice, the phenol content of intake waters must be considered. Phenol and chlorine in water can react to form chlorophenol, which even in trace amounts can impart a medicinal off-flavour to foods.

(5) Maximum permissible concentration may be lower depending on type of substance and its effect on odour and taste.

(6) As required by OWRC Drinking Water Objectives.

(7) The total bacterial count must be considered as a quality requirement for waters used in certain food processing operations. Other than aesthetic considerations, high bacterial concentration in waters coming in contact with frozen foods may significantly increase the count per gram for the food. Waters used to cool heat-sterilized cans or jars of food must be low in total count for bacteria to prevent serious spoilage due to aspiration of organisms through container seams. Chlorination is widely practised to assure low bacterial counts on container cooling waters.

WATER QUALITY CRITERIA FOR THE ELECTRO-PLATING AND METAL FINISHING INDUSTRIES — IWS-5

Plating-room processes that utilize water include the stripping or pickling operations, cleaning by organic solvents or alkaline solutions, rinsing, and electrochemical plating. For acid stripping or for alkaline cleaning, the quality of water used in the baths is seldom critical, for the added chemicals far outweigh the natural constituents of the water. Hardness of water may be detrimental when soaps or alkaline cleaning agents are used.

For rinsing and for plating, water quality is frequently a major problem. High quality water is of primary importance to assure satisfactory finished work. For decorative plating, water spots and stains may necessitate reworking, wiping, buffing, and other laborious operations. Before the application of any organic corrosion-resistant coating, it is almost a necessity to use demineralized water in the final rinse, in order to achieve adhesion of the coating. A high concentration of dissolved solids is especially detrimental in rinse waters.

In plating baths, iron, aluminum, calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulphide, sulphite, sulphate, fluoride, chloride, silicate, copper, and lead have been reported to cause difficulties under certain conditions. Considerable evaporation occurs from plating baths and hence the ions present in the make-up water are concentrated to the extent that they are troublesome.

Calcium and magnesium are especially troublesome in plating baths, for they tend to precipitate to form scale on the heated surface or a sludge in the water. There is a probability of these precipitates being included in the electro-deposit, causing pits, porosity, and roughness. Magnesium may also reduce the "throwing power" in chromium baths, but on the other hand, magnesium sulphate is sometimes added to nickel-plating baths to produce softer deposits, to minimize certain types of pitting, and to increase throwing power.

Sodium and potassium are generally not harmful in plating operations, although sodium may cause brittle deposits in nickel baths or reduce the throwing power in chromium solutions. Iron is one of the most troublesome pollutants of many plating operations. In a nickel-sulphate bath, it may cause hazy, streaked, pitted, or brittle deposits; in acid copper solutions, it produces rough deposits; in chromium baths, it reduces the throwing power; in

cadmium cyanide, it causes hazy deposits; in silver cyanide, stained deposits; and in zinc sulphate baths it lowers the plating efficiency and the protective value of the coating.

Among the anions, bicarbonates are detrimental in heated alkaline baths, for they tend to be converted to carbonates and accelerate the precipitation of calcium. Moreover, they buffer the water and require higher dosages of acid or alkali to obtain the desired pH value. Chlorides have been reported to cause rough, modular, iridescent, and crystalline deposits in cadmium, copper, silver, and tin baths respectively. Organic substances reduce chromium, and cause rough, hazy, streaked, coloured, or pitted deposits under various conditions. Colour and turbidity are similarly objectionable.

Abstracted from "Water Quality Criteria", 2nd Edition, State Water Quality Control Board, California, Publication No. 3-A

TABLE IWS-6

WATER QUALITY CRITERIA FOR THE IRON AND STEEL INDUSTRY

(Unless otherwise indicated, units are mg/l)

Characteristic	Quenching, hot rolling, gas cleaning	Cold rolling	Selected rinse waters: Softened	Selected rinse waters: Demineralized
Suspended solids	25	10	(2)	(2)
Dissolved solids	(1)	(1)	(1)	(2)
Alkalinity ($CaCO_3$)	(3)	(3)	(3)	(2)
Hardness ($CaCO_3$)	(3)	(3)	100	(2)
pH, units	6.0-9.0	6.0-9.0	6.0-9.0	(3)
Chloride (Cl)	150	150	150	(2)
Dissolved oxygen (O_2)	(4)	(4)	(4)	(4)
Temperature, °F	100	100	100	100
Oil	(1)	(2)	(2)	(2)
Floating material	(1)	(2)	(2)	(2)

(1) Accepted as received if meeting total solids or other limiting values.

(2) Zero, not detectable by test.

(3) Controlled by treatment for other constituents.

(4) Minimum to maintain aerobic conditions.

TABLE IWS-7

WATER QUALITY CRITERIA FOR THE PETROLEUM INDUSTRY

(Unless otherwise indicated, units are mg/l)

Characteristic	Concentration
Silica (SiO_2)	(1)
Iron (Fe)	1
Calcium (Ca)	75
Magnesium (Mg)	25
Bicarbonate (HCO_3)	(1)
Sulphate (SO_4)	(1)
Chloride (Cl)	200
Fluoride (F)	(1)
Nitrate (NO_3) as N	(1)
Dissolved solids	750
Suspended solids	10
Hardness ($CaCO_3$)	350
Noncarbonate hardness ($CaCO_3$)	70
Colour, units	(1)
pH, units	6.0-9.0

(1) Accepted as received if meeting total solids or other limiting values.

TABLE IWS-8

WATER QUALITY CRITERIA FOR THE PULP AND PAPER INDUSTRY

(Unless otherwise indicated, units are mg/l)

		Chemical Pulp and Paper	
Characteristic	Mechanical Pulping	Unbleached	Bleached
Silica (SiO_2)	(1)	50	50
Aluminum (Al)	(1)	(1)	(1)
Iron (Fe)	0.3	1.0	0.1
Manganese (Mn)	0.1	0.1	0.05
Zinc (Zn)	(1)	(1)	(1)
Calcium (Ca)	(1)	20	20
Magnesium (Mg)	(1)	10	10
Sulphate (SO_4)	(1)	(1)	(1)
Chloride (Cl)	500	200	200
Dissolved solids	(1)	(1)	(1)
Suspended solids	(1)	10(2)	10(2)
Hardness ($CaCO_3$)	(1)	100	100
pH, units	6.0-9.0	6.0-9.0	6.0-9.0
Colour, units	30	30	10
Temperature, °F	(1)	(1)	95

(1) Accepted as received if meeting total solids or other limiting values.

(2) No gritty or colour-producing solids.

TABLE IWS-9

WATER QUALITY CRITERIA FOR THE LEATHER TANNING AND FINISHING INDUSTRY

(Unless otherwise indicated, units are mg/l)

Characteristic	Tanning Processes	General Finishing Processes	Colouring
Alkalinity ($CaCO_3$)	(1)	130	130
pH, units	6.0-8.0	6.0-8.0	6.0-8.0
Hardness ($CaCO_3$)	150	(2)	(3, 4)
Calcium (Ca)	60	(2)	(3, 4)
Chloride (Cl)	250	250	(5)
Sulphate (SO_4)	250	250	(5)
Iron (Fe)	0.3	0.3	0.1
Manganese (Mn)	0.2	0.2	0.01
Organics:			
Carbon chloroform extract (CCE)	(5)	0.2	(3)
Colour, units	5	5	5
Coliform bacteria, count/100 ml	(6)	(6)	(5)
Turbidity	(3)	(3)	(3)

(1) Accepted as received if meeting total solids or other limiting values.
(2) Lime softened.
(3) Zero, not detectable by test.
(4) Demineralized or distilled water.
(5) Concentration not known.
(6) OWRC Drinking Water Objectives.

TABLE IWS-10

WATER QUALITY CRITERIA FOR THE TEXTILE INDUSTRY

(Unless otherwise indicated, units are mg/l)

Characteristic	Sizing Suspension	Scouring	Bleaching	Dyeing
Iron (Fe)	0.3	0.1	0.1	0.1
Manganese (Mn)	0.05	0.01	0.01	0.01
Copper (Cu)	0.05	0.01	0.01	0.01
Dissolved solids	100	100	100	100
Suspended solids	5	5	5	5
Hardness ($CaCO_3$)	25	25	25	25
pH, units:				
Cotton	6.5-10.0	9.0-10.5	2.5-10.5	7.5-10.0
Synthetics	6.5-10.0	3.0-10.5	(1)	6.5-7.5
Wool	6.5-10.0	3.0-5.0	2.5-5.0	3.5-6.0
Colour, units	5	5	5	5

(1) Not applicable.

4 CRITERIA FOR PUBLIC WATER SUPPLIES (PWS)

Criteria are given for public and private supplies from both surface and ground water sources.

Public supplies include water systems operated by municipalities, public utilities, industries, commissions, commercial establishments, etc. where competent operation of the water supply system is provided.

Private supplies include water systems operated by personnel who may not have the necessary technical or mechanical expertise.

PWS-1 Criteria for Public Surface Water Supplies

Since treatment processes exist which can convert any raw water (with a few minor exceptions) to potable water, it is necessary to define a commonly accepted treatment system which can produce a potable water at a reasonable cost. For the purposes of these criteria, such a system has been defined to consist of coagulation, flocculation, sedimentation and rapid sand filtration; the use of chemicals is restricted by definition to the commonly used coagulants and chlorine for disinfection.

Two types of criteria have been established, namely the Permissible Criteria and the Desirable Criteria (Table PWS-1). Waters meeting both of these criteria are acceptable for treatment by the defined treatment process stated above. Waters meeting the Desirable Criteria provide for a greater margin of safety.

It should be borne in mind that the values given under the Permissible Criteria cannot be considered as maximum single sample values. These criteria should not be exceeded over substantial portions of time. If this should occur, then it will become necessary to determine the cause and initiate corrective action. The frequency and variety of sampling should be based on the findings of a comprehensive pollution survey.

TABLE PWS-1

WATER QUALITY CRITERIA FOR PUBLIC SURFACE WATER SUPPLIES

(Unless otherwise indicated, units are mg/l)

Constituent or Characteristic	Permissible Criteria	Desirable Criteria
Physical		
Colour (platinum-cobalt)	75 units	< 5 units
Odour	Readily removable by defined treatment	Absent
Turbidity	— do —	Absent
Temperature	85°F	Pleasant tasting
Inorganic Chemicals		
Ammonia	0.5 (as N)	< 0.01
Arsenic*	0.05	Absent
Barium*	1.0	Absent
Boron*	1.0	Absent
Cadmium*	0.01	Absent
Chloride*	250	< 25
Chromium* (hexavalent)	0.05	Absent
Copper*	1.0	Virtually absent
Dissolved Oxygen	≥ 4 (monthly mean) ≥ 3 (individual sample)	Near saturation
Fluoride*	See footnote (1)	1.0
Hardness*	Acceptable levels will vary with local hydrogeologic conditions and consumer acceptance.	
Iron (filterable)	0.3	Virtually absent
Lead*	0.05	Absent
Manganese* (filterable)	0.05	Absent
Nitrate plus Nitrite*	10 (as N)	Virtually absent
pH range	6.0 - 8.5 units	Least amount of interference with treatment process
Phosphorus* (phosphates)	Not encourage growth of algae or interfere with treatment process	
Selenium*	0.01	Absent
Silver*	0.05	Absent
Sulphate*	250	< 50
Total Dissolved Solids* (filterable residue)	500	< 200
Uranyl Ion*	5	Absent
Zinc*	5	Virtually absent
Organic Chemicals[2]		
Carbon chloroform extract* (CCE)	0.15	< 0.04
Cyanide*	0.20	Absent
Methylene blue active substances*	0.5	Virtually absent
Oil and grease*	Virtually absent	Absent

Table PWS-1 (cont.)

Constituent or Characteristic	Permissible Criteria	Desirable Criteria
Pesticides:		
Aldrin*	0.017	— do —
Chlordane*	0.003	— do —
DDT*	0.042	— do —
Dieldrin*	0.017	— do —
Endrin*	0.001	— do —
Heptachlor*	0.018	— do —
Heptachlor epoxide*	0.018	— do —
Lindane*	0.056	— do —
Methoxychlor*	0.035	— do —
Organic phosphates plus carbamates*	0.1	— do —
Toxaphene*	0.005	— do —
Herbicides:		
2,4-D plus 2,4,5-T, plus 2,4,5-TP*	0.1	— do —
Phenolic Substances*	Virtually absent	— do —
Radioactivity	(pc/l)	(pc/l)
Gross beta*	1,000	< 100
Radium-226*	3	< 1
Strontium-90*	10	< 2
Microbiological (3)		
Coliform organisms (at 35°C)	5,000/100 ml	< 100/100 ml
Fecal coliforms (44.5°C)	500/100 ml	< 10/100 ml
Fecal streptococci (35°C)	50/100 ml	< 1/100 ml
Total Bacteria (20°C)	100,000/100 ml	< 1,000/100 ml
Clostridia (in water) (35°C)	50/100 ml	0/100 ml

* The defined treatment process has little effect on the constituents.

(1)

Annual Avg. of Max. Daily Air Temp. F.	Recommended Limit for Fluoride mg/l
50.0 to 53.7	1.7
53.8 to 58.3	1.5
58.4 to 63.8	1.3

(2) Organic chemicals should not be present in concentrations as to cause adverse tastes and odours which cannot be removed by the defined treatment and/or by chlorination only.

(3) A monthly geometric mean of the results of raw water samples collected on a weekly basis (minimum of one sample per week) should be less than the numbers given under the Permissible Criteria column. These figures do not imply a relationship between bacterial groups.

PWS-2 Criteria for Public Ground Water Supplies

With the exception of dissolved oxygen, fluorides and microbiological criteria, the water quality criteria for surface water apply to ground water supplies.

For fluorides, hydrogen sulphide and pollution indicator organisms, the following apply to ground water supplies:

	Permissible Criteria	Desirable Criteria
	(Unless otherwise indicated, units are mg/l)	
Fluoride	2.4	1.0
Hydrogen Sulphide	0.1	Absent
Pollution Indicator Organisms	Coliform and other pollution indicator organisms should be virtually absent from all ground water supplies.	

It is considered desirable to provide the maximum of treatment — chlorination — for all ground water supplies. This measure ensures that nuisance organisms which exist in virtually all waters do not get the opportunity to develop a foothold in a water distribution system and thereby create objectionable conditions.

PWS-3 Criteria for Private Water Supplies

The raw water available to private supplies such as individual dwellings, cottages, farms, etc., must be of such quality that it can be used in the raw state or be made acceptable for use with a minimum of treatment limited to disinfection, filtration and/or softening. Economic considerations and lack of technical/mechanical expertise will prohibit the use of raw water supplies that require extensive treatment.

Some surface supplies have turbidities, colour and other undesirable constituents in excess of what can be used effectively in home or farm operations. Some ground water supplies (wells and springs) harbour objectionable gases, nuisance bacteria, in addition to having high concentrations of iron and being highly mineralized. The initial approach in establishing a private water supply should be to explore the ground water potential from the aspects of both quality and quantity. In many instances, deficiencies in ground water quality can be offset at a relatively low cost compared to that for surface waters.

Criteria for private water supplies are identical to the surface water criteria for public water supplies, with the exception of fluorides, hydrogen sulphide, physical and microbiological characteristics. For fluorides and hydrogen sulphide, the applicable criteria appear in Section PWS-2.

Physical Criteria:

The water supply should be substantially free from substances offensive to sight, taste or smell. Threshold odour values in excess of three units are generally considered objectionable.

Colour in the water supply should not exceed 15 units (platinum-cobalt scale).

Turbidity should be less than five units. Turbidities of up to 20 units may be removed relatively easily by sand or diatomaceous earth filters.

Microbiological Criteria:

Microorganisms	Permissible Criteria		Desirable Criteria
	Chlorination only	Chlorination & Filtration	No Treatment
Coliforms (35°C)	100/100 ml	400/100 ml	0/100 ml
Fecal Coliforms (44.5°C)	10/100 ml	40/100 ml	0/100 ml
Enterococci (35°C)	1/100 ml	4/100 ml	0/100 ml
Total Bacteria (20°C)	1000/100 ml	4000/100 ml	10/100 ml
Clostridia (in water) (35°C)	0/100 ml	4/100 ml	0/100 ml

Raw water samples should be collected at least monthly. The Geometric Mean of sample results should not exceed the values given in the table above.

5 CRITERIA OF WATER QUALITY FOR AESTHETICS AND RECREATION (A & R)

All surface waters should be capable of supporting life forms of aesthetic value. The positive aesthetic and recreational values of water should be attained through continuous enhancement of water quality. Surface waters should be of such quality as to provide for the enjoyment of recreational activities such as hunting and fishing which are based on the utilization or consumption of fish, waterfowl and other forms of life.

The aesthetic and recreational values of unique or outstanding waters should be recognized and protected by development of appropriate water quality standards for each individual case. To retain or establish unspoiled wilderness values, it may be necessary to control access by mechanized methods of transportation.

General criteria for recreation and aesthetic use and specific criteria for total body contact recreation follow:

A & R-1 General Criteria for Recreation and Aesthetics

Surface waters should be free of substances attributable to discharge of waste or land drainage which may impair aesthetic or recreational use, as follows:

(1) Materials that will settle to form objectionable deposits.

(2) Floating debris, oil, scum and other matter.

(3) Substances producing objectionable colour, odour, taste or turbidity.

(4) Materials, including radionuclides, in concentrations or combinations which are toxic or which produce undesirable physiological responses in humans, fish and other life and plants.

(5) Substances, including nutrients, and conditions, including temperature, or combinations thereof in a degree or concentration which produces undesirable types or abundance of aquatic life.

A & R-2 Criteria for Total Body Contact Recreation

Surface waters for total body contact recreational use should be free of substances attributable to discharge of waste or land drainage as follows:

(1) Materials which will cause the pH to change beyond the range 6.5-8.3.

(2) Materials which will obscure visibility in the water. In designated swimming and diving areas, clarity should be such that a Secchi Disc on the bottom is visible from the surface.

(3) Conditions which will cause the water temperature to exceed 85°F.

(4) Microbiological Criteria
Water used for body contact recreational activities should be free from pathogens including any bacteria, fungi or viruses that may produce enteric disorders or eye, ear, nose, throat and skin infections. Where ingestion is probable, recreational waters can be considered impaired when the coliform, fecal coliform, and/or enterococcus geometric mean density exceeds 1000, 100 and/or 20 per 100 ml respectively, in a series of at least ten samples per month, including samples collected during weekend periods.

If these criteria are exceeded, it will become necessary to determine the cause and initiate corrective action.

When evaluating a given area of water for recreational use, the appropriate numbers of samples, and the choice of tests to be performed should be determined by consultation between sampler and analyst, prior to sampling. An effort should be made to increase utilization of the fecal coliform and enterococcus tests since these presently appear to be the more relevant guides to the bacterial quality of bathing waters.

GLOSSARY OF TERMS

Bioassay	—	A controlled laboratory procedure which subjects live aquatic organisms to various environmental stresses.
Effluent Requirements	—	Numerical or verbal descriptions of the quality of a waste or drainage effluent at the point of discharge to a receiving water body, land disposal site or waste disposal well.
Eutrophication	—	The increase in the nutrient content of the natural waters of a lake or other body of water.
Geometric Mean	—	The nth root of the product of n observations. The equation for the geometric mean (G_x) can be expressed as: $G_x = \sqrt[n]{X_1 . X_2 . X_3 \ldots\ldots\ldots . X_n}$ or $G_x = \text{antilog}\left(\frac{\log X_1 + \log X_2 + \ldots . \log X_n}{n}\right)$
Land Drainage	—	Water that has drained from the land surface naturally or through man-made drainage systems.
Milligrams per Litre (mg/l)	—	A unit of measure expressing the concentration of a substance in a solution.
Milligram equivalents per litre (mg. eq/l)	—	A unit indicating the chemical equivalence of ions; derived by dividing the concentration of an ion in milligrams per litre by the combining weight of that ion. Note: combining weight $= \frac{\text{atomic or molecular weight of ion}}{\text{ionic charge}}$
Oligotrophic	—	Waters with a small supply of nutrients and hence a small organic production; usually having abundant dissolved oxygen at all depths.
Photosynthetic (adj.)	—	Relating to the process by which the chlorophyl-bearing cells of green plants convert carbon dioxide (CO_2) and water (H_2O) into sugar ($C_6H_{12}O_6$) and oxygen (O_2) in the presence of light.
Raw Water	—	Surface or ground water, prior to treatment.
Waste	—	Liquid carrying unwanted materials or compounds resulting from human activities or enterprises to a point of discharge. The mixture may or may not have received treatment.
Water Quality Criteria	—	Numerical or verbal descriptions of the quality of water required for particular uses.
Water Quality Standards	—	Numerical or verbal descriptions of the quality of water required for a variety of uses in a given drainage system.

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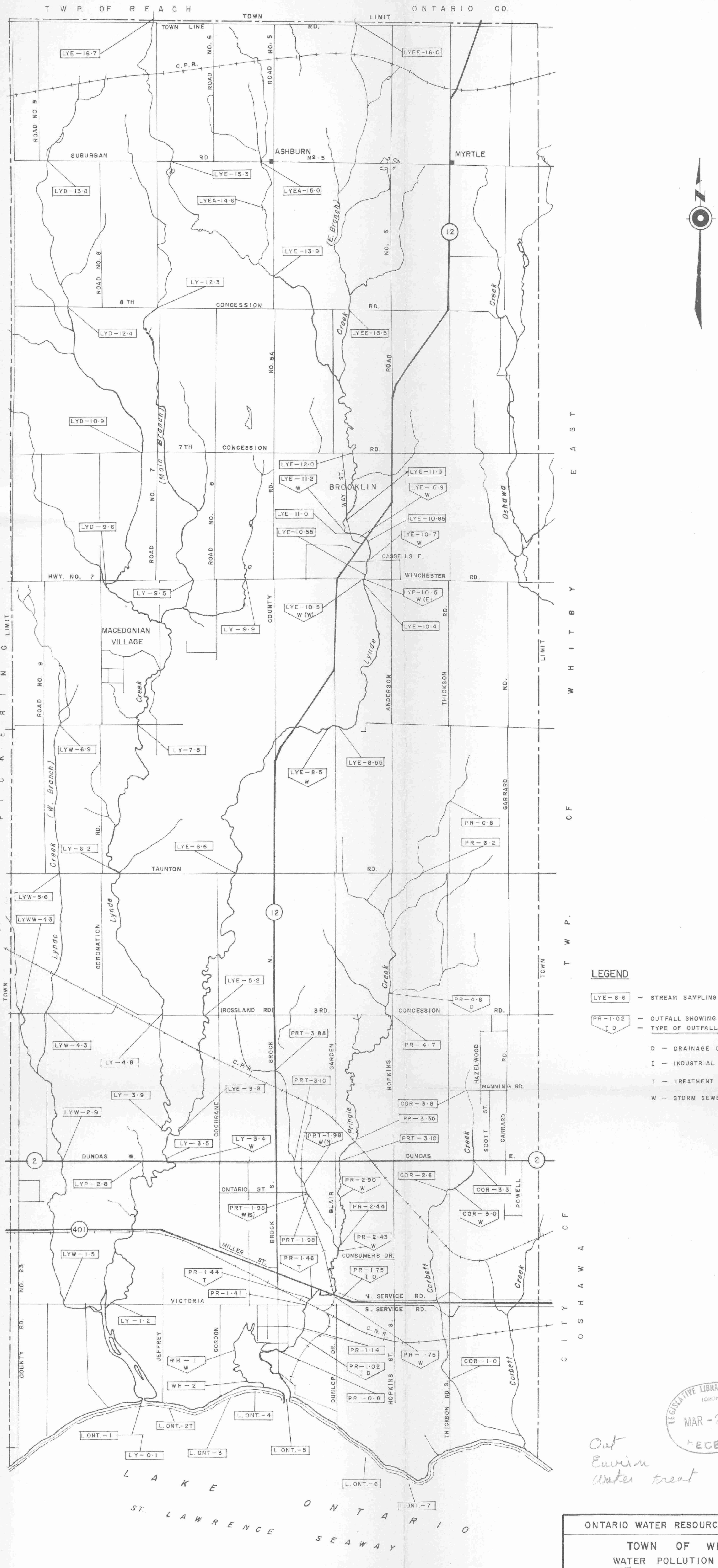

LEGEND

LYE-6·6 — STREAM SAMPLING POINT SHOWING MILEAGE

PR-1·02 I D — OUTFALL SHOWING STREAM AND MILEAGE — TYPE OF OUTFALL

D — DRAINAGE DITCH

I — INDUSTRIAL WASTE EFFLUENT

T — TREATMENT PLANT EFFLUENT

W — STORM SEWER

ONTARIO WATER RESOURCES COMMISSION

TOWN OF WHITBY

WATER POLLUTION SURVEY

1971

SCALE: 2800 0 2800 5600 FT	
DRAWN BY: L. L. BROOME	DATE: MAY, 1971
CHECKED BY: J. C.	DRAWING Nº: 71-42-DE